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ALFRED E. FORSTALL,

Montclair, N. J.

VOLUME XV. DECEMBER, 1898.

PROCEEDINGS

OF THE

American Gas Light Association,

TWENTY-SIXTH ANNUAL MEETING

HELD AT

NIAGARA FALLS, OCTOBER 19, 20 and 21, 1898.

PUBLISHED BY THE ASSOCIATION.

EDITED BY THE SECRETARY.

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J. B. Crockett

THE PROCEEDINGS

OF THE

American Gas Light Association.

TWENTY-SIXTH ANNUAL MEETING,

HELD AT THE

INTERNATIONAL HOTEL, NIAGARA FALLS, N. Y.

OCTOBER 19TH AND 20TH, 1898.

FIRST DAY—MORNING SESSION.

The Association was called to order at 10 o'clock, A. M., by the President, Mr. J. B. Crockett.

The following members were in attendance:

Honorary Members.

Barker, Forrest E.,	Boston, Mass.
Foote, Allen R.,	Tacoma Park, D. C.
Love, E. G.,	New York, N. Y.

Active Members.

Adams, H. C.,	Philadelphia, Pa.
Africa, Walter G.,	Manchester, N. H.
Barret, A. H.,	Louisville, Ky.
Barrett, W. E.,	Ardmore, Pa.
Baxter, Isaac C.,	Detroit, Mich.
Beadle, A. B.,	Philadelphia, Pa.
Beal, W. R.,	New York, N. Y.
Bigelow, A. F.,	Allentown, Pa.
Blodget, C. W.,	Brooklyn, N. Y.
Boardman, A. E.,	Macon, Ga.

Borgner, Cyrus,	Philadelphia, Pa.
Bowen, W. S.,	Newport News, Va.
Bredel, Frederick,	Milwaukee, Wis.
Brown, R. B.,	Philadelphia, Pa.
Buckman, James,	Philadelphia, Pa.
Burke, J. E.,	Princeton, N. J.
Bush, J. S.,	New York, N. Y.
Butterworth, Irvin,	Columbus, Ohio.
Callender, E. P.,	New York, N. Y.
Cartwright, William,	Philadelphia, Pa.
Cathels, Edmund,	Hamilton, Ont.
Chollar, B. E.,	St. Louis, Mo.
Clark, Walton,	Philadelphia, Pa.
Clarke, G. S.,	Kansas City, Mo.
Clary, E. D.,	Burlington, Ia.
Corbett, C. H.,	Brooklyn, N. Y.
Cowdery, E. G.,	Milwaukee, Wis.
Cowing, John H.,	Buffalo, N. Y.
Cressler, A. D.,	Fort Wayne, Ind.
Crisfield, J. A. P.,	Savannah, Ga.
Crockett, J. B.,	San Francisco, Cal.
Curley, Thomas,	Wilmington, Del.
Daly, D. R.,	Jersey City, N. J.
Dell, John,	St. Louis, Mo.
Diall, M. N.,	Terre Haute, Ind.
Dickey, C. H.,	Baltimore, Md.
Dickey, R. R.,	Dayton, Ohio.
Doherty, H. L.,	Madison, Wis.
Doty, Paul,	Grand Rapids, Mich.
Dunbar, C. H.,	Elgin, Ill.
Egner, Frederick,	Norfolk, Va.
Eilbeck, A B.,	Philadelphia, Pa.
Faben, C. R., Jr.,	Toledo, Ohio.
Flemming, Dudley D.,	Jersey City, N. J.
Forstall, A. E.,	Montclair, N. J.
Forstall, Walton,	Philadelphia, Pa.
Fry, C. G.,	Lynn, Mass.
Geggie, D. H.,	Quebec, Canada.
Gerould, C. L.,	Mt. Vernon, N. Y.
Giblin, J. A.,	Ilion, N. Y.

Glasgow, A. G., - - - London, Eng.
Glass, S. J., - - - - Milwaukee, Wis.
Goodwin, W. W., - - - Philadelphia, Pa.
Greenough, M. S., - - - Cleveland, Ohio.
Gribbel, John, - - - Philadelphia, Pa.
Guldlin, Olaf N., - - - Fort Wayne, Ind.
Harbison, J. P., - - - Hartford, Ct.
Harper, G. H., - - - - Altoona, Pa.
Harris, J. A., - - - - Philadelphia, Pa.
Helme, Wm. E., - - - Philadelphia, Pa.
Herron, J. T., - - - Buffalo, N. Y.
Humphreys, Alex. C., - New York, N. Y.
Humphreys, C. J. R., - - Lawrence, Mass.
Jenkins, E. H., - - - - Buffalo, N. Y.
Jourdan, J. H., - - - Brooklyn, N. Y.
Kellogg, L. L., - - - - Sioux City, Iowa.
Keppleman, J. H., - - - Reading, Pa.
Kreischer, G. F., - - - New York, N. Y.
Leach, H. B., - - - Taunton, Mass.
Learned, C. A., - - - - Meriden, Conn.
Little, F. W., - - - Akron, Ohio.
Littelhales, T., - - - - Syracuse, N. Y.
Ludlam, Edwin, - - - Brooklyn, N. Y.
Lynn, J. T., - - - - Detroit, Mich.
McDonald, Wm., - - - Albany, N. Y.
McIlhenny, John, - - - Philadelphia, Pa.
Miller, Alten S., - - - New York, N. Y.
Miller, Wm. A., - - - Cincinnati, Ohio.
Milsted, Wm. N., - - - New York, N. Y.
Morrell, E. E., - - - - Oak Park, Ill.
Morton, Fred N., - - - Hoboken, N. J.
Neal, George B., - - - Boston, Mass.
Nettleton, C. H., - - - Derby, Conn.
Norris, Rollin, - - - - Philadelphia, Pa.
Nute, J. E., - - - - Fall River, Mass.
Pearson, W. H., - - - Toronto, Canada.
Pearson, Wm. H., Jr., - - Toronto, Canada.
Pinkney, E. A., - - - - Utica, N. Y.
Poor, Frank B., - - - Hackensack, N. J.
Pratt, E. G., - - - - Des Moines, Iowa.

Prichard, C. F.,	Lynn, Mass.
Quinn, A. K.,	Newport, R. I.
Ramsdell, G. G.,	Philadelphia, Pa.
Raynor, C. H.,	Adrian, Mich.
Reichelt, A. F..	New York, N. Y.
Rice, H. L.,	Norfolk, Va.
Roots, D. T.,	Connersville, Ind.
Rowland, W. L.,	Philadelphia, Pa.
Rusby, J. M.,	Jersey City, N. J.
Russell, D. R.,	St. Louis, Mo.
Searle, R. M.,	Atlanta, Ga.
Shelton, F. H.,	Philadelphia, Pa.
Sisson, F. N.,	Albany, N. Y.
Slater, H. C.,	Milwaukee, Wis.
Somerville, James,	Indianapolis, Ind.
Stacey, William,	Cincinnati, Ohio.
Strecker, A. H.,	Newark, N. J.
Summers, T. W.,	Hornellsville, N. Y.
Thwing, O. O.,	St. Louis, Mo.
Warmington, D. R.,	Cleveland, Ohio.
Watson, Charles,	Camden, N. J.
Weber, Oscar B.,	New York, N. Y.
Wheeler, F. B.,	Binghamton, N. Y.
White, H. H.,	Portsmouth, Va.
White, Wm. Henry,	New York, N. Y.
Woods, Geo. E.,	New York, N. Y.
Wortendyke, I. F.,	Janesville, Wis.
Young, J. M. H.,	Pittsburg, Pa.
Young, John,	Allegheny, Pa.
Young, Peter,	Buffalo, N. Y.
Young, Robert,	Pittsburg, Pa.

Associate Members.

Carpenter, H. A.,	Allegheny, Pa
Collins, D. J.,	Philadelphia, Pa.
Crane, W. M.,	New York, N. Y.
Eaton, A. B.,	Chicago, Ill.
Graves, G. W.,	Rochester, N. Y.
Hartenfels, P.,	New York, N. Y.

Hayward, S. F.,	New York, N. Y.
Henderson, E. H.,	Pittsburg, Pa.
Knight, C. S.,	Fort Wayne, Ind.
Mansur, J. H.,	Royersford, Pa.
McDonald, Donald,	Albany, N. Y.
Norton, Harry A.,	Boston, Mass.
Osius, George,	Detroit, Mich.
Page, A. L.,	New York, N. Y.
Pearson, J. A.,	Philadelphia, Pa.
Persons, F. R.,	Toledo, Ohio.
Prendergast, D. R.,	New York, N. Y.
Roper, G. D.,	Rockford, Ill.
Wells, F. K.,	Chicago, Ill.
Wharton, Henry,	Philadelphia, Pa.
Wilbraham, John S.	Philadelphia, Pa.

The President introduced Mr. Arthur C. Hastings, Mayor of Niagara Falls.

Mayor Hastings: — Mr. President and Gentlemen of the American Gas Light Association: When Mr. Jenkins wrote to me, asking if I would speak a few words of welcome at the meeting of your Association here on the 19th inst., I replied that it was rather a delicate subject for an outsider to attempt to address an Association like this on the matter of gas; but he said that you were not at all thin-skinned, and that he had heard of other people who had a meter in their own house. So I felt somewhat easier after this expression by Mr. Jenkins. As a young man, I attended Sunday-school for several years, and my teacher was the Superintendent of the Gas Works in the place, which was quite a large city, and, by the way, I have never since seen a Gas Superintendent who was a Sunday school teacher.

I was seeking information from him and I asked him how it was that they kept track of the amount of gas that they sold, as compared with the amount that they made, how they made the comparison between the bills collected, and the gas they made. He said, "Why, we have a large meter in the gas house, and all the bills that come in at the end of the year are compared with this meter, and there is always an agreement between the two." Sometimes I have watched my meter at home, and I judge that it was

set by clock work, for I have noticed that it ran right along whether the gas was used or not; and when I asked the Superintendent here how that could be, he said that it was an error, and that he would put in a new meter; but the second one he put in was worse than the first.

The welcome that I would officially extend to you seems really unnecessary, for the day itself is all that we can ask for, and it seems to have lightened for your benefit. We have had here a week of dark and dreary weather, but it has cleared up this morning for your especial benefit, and I believe will so continue while you are here.

There is surely a great deal in this city which will be of interest to you as manufacturers. We have here two power plants which are probably the largest in the world, and they are carrying power and light from here to Buffalo and Lockport, and are running the cars from twenty-five to thirty miles all around us, by the use of Niagara's power. We believe that we have here a city which will in a very few years compare very favorably with any of the cities represented by the delegates here to-day.

I trust that you will make yourselves at home; that you will see all that we have to offer in the way of manufacturing facilities and of scenic beauty; and that you will all come here again, individually and collectively. The gates of the city are open to you, and if any of you want to borrow the keys, I will loan them to you.

THE PRESIDENT:—Mr. Greenough will reply for the Association.

MR. GREENOUGH:—Mr. Mayor, the President of the Association has pleaded the fact that he is suffering from a severe cold in the head, and has asked me to take his place in replying for the Association to your welcome. If this were a difficult matter, I might plead lack of preparation; but to thank you for your cordial welcome to the Association is so easy a thing to do, that I take very great pleasure in acting as the Association's spokesman for that purpose.

I think it may not be improper, Mr. Mayor, to say a word in behalf of this Association. I think that the managers of Gas Companies when they come together are ordinarily represented by the newspapers as a set of ravenous wolves seeking whom they may devour. I beg leave to assure you that you have had in your

city this summer no more hard working or conscientious set of men than those which represent the gas companies here to day. It is more than twenty-five years since this Association first commenced, and during that time we have met annually and discussed the affairs of our business. I can assure you that the benefit to the public from these meetings has been a very great one Twenty-five years ago, I do not think there was a city in the United States that was selling gas for much less than $2.50 per thousand cubic feet; now there is hardly a large city in the United States where gas is sold for much over a dollar. These meetings have been held for the purpose of enabling the members, who are for the most part the active managers of gas companies, to compare their notes, and to discuss all matters which tend either to the cheapening of the product, to its improvement for gas lighting, or to the lessening of the cost of distribution. The result has been most distinctly and markedly in favor of the public, as well as of the Gas companies. It was long ago discovered by the managers of Gas companies that that manager served his company best who also served the public best; and that has been the object and aim of the American Gas Light Association from its inception up to the present day. We have nothing to conceal, Mr. Mayor; there is nothing said or done in these meetings which is not open to the public, and I beg to offer to you and to any other gentleman who is interested in any way in the discussions which may take place at this meeting, the entire freedom of our body while we are in session here, and we should be glad to see you, and to have you, if you see fit to do so, take part in the discussions. In behalf of this Association, I thank you most cordially for the welcome you have extended to us.

THE PRESIDENT:—The first business in order will be the reading of the minutes of the last annual meeting. I think those minutes have been printed, and a motion to dispense with the reading would be in order.

MR. NEAL:—I move that the reading be dispensed with, and that the minutes as printed be approved.

Carried.

THE PRESIDENT:—Next in order is the report of the Council on Applications for Membership and Transfers of Membership.

The Secretary read the following report:

NIAGARA FALLS, October 19, 1898.

To the American Gas Light Association.

GENTLEMEN:—Your Council has approved the following applications for membership, and submit them to you with a recommendation that they receive favorable action:

Proposed for Active Membership.

Aldrich, W. A., Spokane Falls, Washington, Secretary Spokane Falls Gas Light Co.

Andrews, J. Charles, 19th and Allegheny Avenues, Philadelphia, Pa., Superintendent of Meters, United Gas Improvement Co., Philadelphia Gas Works.

Bailey, William, Oskaloosa, Iowa, Secretary and Manager Oskaloosa Gas Co.

Battin, H. S., 4257 Frankford Avenue, Philadelphia, Pa., District Superintendent (Distribution) United Gas Improvement Co.

*Boore, Louis A., Niagara Falls, N. Y., Secretary Niagara Falls Gas Light Co.

*Buck, H. M., Peru, Indiana, Superintendent Peru American Gas Co.

*Cathels, Wm. M., Brantford, Ontario, Manager Brantford Gas Co., Ltd.

*Chandler, W. G., 30 North Third Street, Harrisburg, Pa., Agent and Superintendent The United Gas Improvement Co., Harrisburg Gas Works.

*Clahan, John J., 133 Whitney Place, Buffalo, N. Y., Superintendent of People's Gas Light & Coke Co.

Clements, John, Red Bluff, California, Secretary Red Bluff Electric Light and Gas Co.

Cline, W. B., Los Angeles, California, President Los Angeles Lighting Co.

Cross, Philip, Detroit Club, Detroit, Mich., Assistant General Manager Detroit City Gas Co.

*Present at Meeting.

*Dawes, Beman G., Newark, Ohio, President and Treasurer Newark Gas Light and Coke Co. and Lansing Gas Light Co.

Donahue, E. J., 813 Drexel Building, Philadelphia, Pa., Consulting Engineer Sioux Falls Gas Light Co., Sioux Falls, South Dakota.

*Douthirt, W. F., 40 Wall Street, New York, N. Y., Assistant Secretary Buffalo City Gas Co.

*Dunderdale, Thos., 23 Sparks Street, Ottawa, Canada, Superintendent Ottawa Gas Co.

Dutton, Lewis R., Wyncote, Pa., Superintendent The Jenkintown and Cheltenham Gas Co.

Gartley, Alonzo, 813 Drexel Building, Philadelphia, Pa., Consulting Engineer Johnstown and Gloversville Gas Co.

*Hadden, James M., Poughkeepsie, N. Y., Manager Poughkeepsie Gas Works.

*Hall, Arthur H., 350 Alexander Avenue, New York, N. Y., Superintendent of Distribution, Central Union Gas Co.

Hofmann, G. Max, Fort Wayne, Ind., General Superintendent Fort Wayne Gas Co.

*Humphreys, James J., Jr., Worcester, Mass., Superintendent Worcester Gas Light Co.

*Jones, T. C., Delaware, Ohio, Superintendent and Secretary Delaware Gas Company.

Kempf, John, Salt Lake City, Utah, General Manager, Salt Lake and Ogden Gas & Electric Light Co.

*Knapp, Isaac N., 20th and Centre Streets, Omaha, Neb., Superintendent Omaha Gas Co.

Knight, D. E., Marysville, Cal., President Marysville Gas Co.

Lawrence, W. F., Trenton, N. J., Superintendent Trenton Gas Light Co.

Littlehales, Thomas G., Hopkinsville, Ky., Lessee and Manager Hopkinsville Gas and Lighting Co.

*Mayers, J. A., 131 Lafayette Avenue, Detroit, Mich., Superintendent of Streets, Detroit City Gas Co.

McLean, George, Dubuque, Iowa, Secretary and Manager, Key City Gas Co.

*Present at Meeting.

*Merrifield, L. L., 157 Dowling Avenue, Toronto, Canada, Engineer Canadian Gas Association, Engineer Belleville Gas Co., Ontario.

Moore, Northrop, Kansas City, Kansas, Superintendent Wyandotte Gas Co.

*Morrison, H. K., Concord, N. H., Superintendent Concord Light and Power Co.

Norton, Walter F., 55 Concord Street, Nashua, N. H., Superintendent Nashua Light, Heat and Power Co.

*Parker, Richard Marsh, 420 Market Street, McKeesport, Pa., Treasurer McKeesport Gas and Improvement Co.

Parker, T. R. Napa, Cal., General Manager Napa City Gas Light and Heating Co.

Quilty, C. W., San José, Cal., President San José Light and Power Co.

Rosenthal, Albert, 1315 Filbert Street, Philadelphia, Pa., Superintendent of Special Mains, Philadelphia Gas Works, U. G. I. Co.

Ross, J. Charles, Port Chester, N. Y., Superintendent Westchester Gas and Electric Co.

*Rossman, G. M., Keene, N. H., Treasurer Keene Gas Light Co.

Scott, William M., Lewiston, Me., Superintendent Lewiston Gas Light Co.

*Shattuck, John D., 720 Ellincott Square, Buffalo, N. Y., Engineer of Distribution, People's Gas Light and Coke Co.

*Spragle, L. D., Johnstown, N. Y., Superintendent Johnstown and Gloversville Gas Co.

Thomas, John W., Vallejo, Cal., Superintendent Vallejo Gas Light Co.

Tuthill, J. B. T., Salem, Oregon, General Manager, Salem Gas Co.

*Wakeman, E. A., Batavia, N. Y., Superintendent Consolidated Gas and Electric Co.

*Wales, Harry B., Grand Rapids, Mich., Chief Clerk Grand Rapids Gas Light Co.

*Wells, L. W., Canton, Ohio, Superintendent Canton Gas Light and Coke Co.

*Present at Meeting.

*Whipple, Henry S., Rockford, Ill., Superintendent Rockford Gas Light and Coke Co.

*Whittaker, Alan Dean, Paterson, N. J., Assistant Superintendent The United Gas Improvement Co.

*Williams, L. S., 706 North 8th Street, Sheboygan, Wis., Superintendent Sheboygan National Gas Co.

*Witherby, Edwin E., Lockport, N. Y., Superintendent and Secretary Lockport Gas and Electric Light Co.

*Woodward, Ralph, New Rochelle, N. Y., Superintendent New Rochelle Gas and Fuel Co.

Proposed for Associate Membership.

Alcott, Franklyn L., Cleveland, Ohio, General Manager and Secretary The Standard Lighting Co.

Atwater, Christopher G., Syracuse, N. Y., Engineer Semet-Solvay Co.

Bartlett, D. Lewis, care Bartlett, Hayward & Co , Baltimore, Md., Manufacturer Gas Works Apparatus.

Battin, William I., 3701 Powelton Avenue, Philadelphia, Pa., Foreman of Mains, West Philadelphia District, Philadelphia Gas Works, U. G. I. Co.

*Bayles, James C., M. E., Ph.D., 14 Cortlandt Street, New York, N. Y., Chief Engineer Bayles Engineering Co.

*Coleman, H. W., 625 Drexel Building, Philadelphia, Pa., Eastern Agent, Kerr Murray Manufacturing Co.

*DeHart, J. S., Jr., 46 Bridge Street, Newark, N. J., Engineer with Isbell-Porter Co.

Duck, George F., 1 Broadway, New York, N.Y., Gas Coal Agent, Peale, Peacock and Kerr.

Floyd, James R., Jr., 539 West 20th Street, New York, N. Y., member of firm of James R. Floyd's Sons.

Osborne, Willard B., Allegheny, Pa., Constructing Engineer Riter-Conley Co.

Poole, Herman, Care American Gas Light Journal, 32 Pine Street, New York, N. Y., Consulting Chemist and Engineer.

Summey, D. L., Wyncote, Pa., Engineer The Jenkintown and Cheltenham Gas Co.

*Present at Meeting.

Trenkamp, H. J., Cleveland, Ohio, Secretary The Schneider & Trenkamp Co.

*Wehner, R. K., 46 Bridge Street, Newark, N. J., Manager Isbell-Porter Co.

Transfers from Associate to Active.

Knight, C. S., Murfreesboro, Tenn., Secretary Murfreesboro Gas and Electric Light Co.

Randolph, William W., 31 Nassau Street, New York, N. Y., Assistant to the President Syracuse Gas Co., N. Y. and City Gas Co of Norfolk, Va.

Number of Applications—Active	53
Associate	14
Total	67
Transfer	2

Respectfully submitted for the Council,

ALFRED E. FORSTALL, *Secretary.* J. B. CROCKETT, *President.*

On motion of Mr. Humphreys, the Secretary was directed o cast the ballot of the Association for the election of those named in the report. Mr. Neal was appointed teller; the ballot was cast by the Secretary as directed, and the applicants were declared duly elected members of the Association.

THE PRESIDENT:—If there are any present whose names have been read, I will ask them to rise and be introduced to the members of the Association. Gentlemen, I am very glad to welcome you to the Association as members, and I am sure you will all become useful members.

Next in order is the report of the Council on the management of the affairs of the Association during the past year.

The Secretary read the following:

REPORT OF COUNCIL.

NIAGARA FALLS, October 19, 1898.

To the American Gas Light Association.

GENTLEMEN:—Your Council has the honor to make its annual report as follows:

*Present at Meeting.

A separate report upon applications for membership recommends the election of 67 applicants.

The resignations of ten Active and two Associate members have been received and accepted.

The following list of papers has been approved to be read at this meeting:

"Depth of Fire in a Water Gas Set," by J. M. Rusby, Jersey City, N. J.

"Notes on Mains and Main Laying," by Walton Forstall, Philadelphia, Pa.

"The Loss of Illuminating Power of 25 to 30 Candle Gas when Mixed with Air," by Dr. E. G. Love, New York, N. Y.

"Can We Make All Our Business Pay?" by A. E. Forstall, Montclair, N. J.

"How Can We Make the Use of Gas for Cooking More Universal?" by Henry L. Doherty, Madison, Wis.

A Committee of the Council has been employed for the past year in devising ways and means for carrying on the work of the Educational Committee, which Mr. Walton Clark, its Chairman, has been compelled to relinquish. Upon their report submitted to the Council last night, the Council recommend to the Association that action be taken as follows:

That a Board of Trustees be formed to administer the funds to be collected and to have full charge of the educational work, including the employment of the working force; the Trustees to have full authority in the premises.

That the Board consist of three members appointed by the Association from its membership, and of the President and Junior Past-President of the Association, *ex-officio;* vacancies to be filled by the Trustees themselves.

That the three members to be appointed by the Association be as follows: Walton Clark, Eugene Vanderpool, W. F. Douthirt.

That authority be given to the officers of the Association to perform such acts on behalf of the Association as may be necessary or desirable in connection with the creation of the Board of Trustees of the Educational Fund.

The Council recognizing the self-sacrifice, zeal and ability displayed by Mr. Walton Clark in carrying on the work of the Com-

mittee on Education, from February, 1896, to June of this year, recommend that the Association pass a special vote of thanks to Mr. Clark for his labors in the field, and for demonstrating that such an educational scheme can be carried out to the benefit of many a deserving man.

The medal offered by Mr. Beal, to be presented to the writer of the best paper presented at each meeting, has been struck off, and handed to the Council for presentation, as decided by the proper committee.

Respectfully submitted,

ALFRED E. FORSTALL, *Secretary.* J. B. CROCKETT, *President.*

To this was appended the following report:

To the Council of the American Gas Light Association:

REPORT OF COMMITTEE ON SECRETARYSHIP AND ON EDUCATION.

At the annual meeting in '96, a Committee was appointed by the Council to consider the questions which had arisen in connection with the difficulties which had been experienced in properly filling the office of Secretary, in view of the large amount of work and responsibility attached to the office and of the inability of the Association to offer an adequate compensation therefor.

At the next spring meeting this Committee reported progress.

At the annual meeting following ('97) this Committee in reporting, pointed out the difficulty likely to be soon experienced in the carrying on of the work of the Educational Committee, through the inability of Mr. Walton Clark to continue his labor of love as Chairman and working member of the Committee. This Committee then pointed out the possible relationship between these two subjects, viz.: the Secretaryship and the Educational Work of the Association.

At the following meeting, spring of this year, this Committee laid before the Council a fairly definite scheme for the continuance of the Educational work through a Board of Trustees, to work without compensation, but to be authorized to engage the services of a competent Secretary to act as Instructor, the expenses of the

Trustees (chiefly the salary of the Secretary) to be met by subscriptions from Gas Companies and individuals, to extend over five years and thus to insure the continuance of the work for that time, the amount to be so pledged to be not less than $3,000 per annum. This scheme was in general approved by the Council, and this Committee was instructed to proceed along the lines so laid out, and to report finally at this meeting.

In accordance with these instructions, your Committee in June last issued a circular and subscription form and placed them generally before the Gas Companies of the United States and before firms and individuals connected with our business.

In response to this appeal and to the personal appeals made by the members of your Committee, annual subscriptions have been already pledged to the amount of $3,193.

It is to be noted that the response has not been as general as might be wished, but your Committee trusts that this may be in part corrected by the receipt of further subscriptions now under consideration.

In view of the possibility of some of the subscriptions being canceled before the five years have elapsed, your Committee considers that it is extremely desirable that the subscription list should be kept open. Any amount which may be obtained in excess of the anticipated requirements can be well invested as a permanent fund to form the nucleus for the subscriptions five years hence, when, we feel sure, the value of this work will have been demonstrated, and the necessity for continuing it will be manifest.

It is also desirable that we should have something in excess of the $3,000 per year, for it is contemplated that this amount will be required for the salary of the Board's permanent Secretary, and the Board will be at some little expense for printing and postage, which has in the past amounted to about $250 a year. This item, it is quite likely, will be necessarily increased, and certainly will be, if the class increases in size, as now appears probable.

The Association for the three years past has reimbursed the Educational Committee for its actual cash expenditures in this line, and we might therefore continue to ask the Association to appropriate sufficient to cover these petty expenditures. The Association can well afford to appropriate $250 per year for this purpose, and we suggest a recommendation to this effect.

One of the objections your Committee has had to meet in filling up the subscription list, has been the reluctance of some, and especially individuals, to pledge themselves to an annual payment extending over such a considerable time as five years. We would therefore suggest the advisability of endeavoring to obtain subscriptions of lump sums, to be paid in without pledge as to the future, it being understood by the Trustees that such amounts shall either go with a general fund, the interest alone of which shall be used, or that not more than one-fifth of such lump-sum-subscriptions shall be appropriated in any one year. This has been the disposition of the lump-sum-subscriptions already made. We feel sure that if this feature is clearly placed before the members of the Association, either by this Committee or by the Trustees, when appointed, the result will be to considerably swell the subscription list, and to considerably widen the interest in the scheme.

Your Committee suggests that the Council recommend to the Association the formation of a Board of Trustees to administer the funds to be collected and to have full charge of the Educational work, including the employment of the working force; the Trustees to have full authority in the premises.

We would further suggest that the Council recommend that the Board consist of three members appointed by the Association from its membership, and of the President and Junior Past-President of the Association, *ex-officio;* vacancies to be filled by the Trustees themselves.

Your Committee further suggests that the Council recommends to the Association the following members for the Board of Trustees:

WALTON CLARK,
EUGENE VANDERPOOL,
W. F. DOUTHIRT.

We further suggest for recommendation to the Council that authority be given to the Officers of the Association to perform such acts on behalf of the Association as may be necessary or desirable in connection with the creation of the Board of Trustees of the Educational Fund.

Your Committee, while not charged with responsibility in the matter of the selection of a proper person to act as Secretary of the Board of Trustees, found it necessary to look far enough into this

question to determine whether or no the proper man could be obtained at the salary contemplated, viz.: $3,000 per annum. We also found that many of the subscribers wished to be assured that the proper material was available.

Recognizing the desirability of coupling together the work of the Secretaryship of the Association with this Educational Work in case the Secretary of the Association was a man properly equipped by training and temperament for the Educational Work, and recognizing that the present Secretary is peculiarly fitted to fill both offices, we felt warranted in sounding him on the subject, and we are happy to be able to report that if he is appointed to both of these offices, he will be prepared to take up the work and devote himself almost exclusively to the duties of the two offices. He will under these circumstances expect to do consulting work, but his first care will be the work of the Association and of the Educational Board. It is understood that if this arrangement is consummated Mr. Forstall will receive the same salary from the Association as at present, and will be reimbursed for cash expended for printing, postage, etc., as at present. He would expect to hire an office in New York City at his own expense, and would establish therein headquarters for the Association and for the Educational Board.

In concluding this report, we wish to again refer to the self sacrifice, zeal and ability displayed by Mr. Walton Clark in carrying on the work of the Committee on Education from February, 1896, to June of this year. Few understand the amount and quality of this work.

We suggest that the Council recommend to the Association a special vote of thanks to Mr. Clark for his labors in the field, and for demonstrating that such an educational scheme can be carried out to the benefit of many a deserving and struggling man.

Respectfully submitted,

ALEX. C. HUMPHREYS,
CHARLES H. NETTLETON,
GEORGE G. RAMSDELL,
Committee.

Niagara Falls, October 18, 1898.

On motion of Mr. Shelton the report was accepted and its recommendations adopted.

The Secretary read the following report of the Treasurer and Secretary, and the report of the Finance Committee, which were, on motion of Mr. White, received and placed on file.

REPORT OF TREASURER FOR YEAR ENDING SEPT. 30, 1898.

Receipts.

Dues for year 1891	$ 5 00	
" 1892	5 00	
" 1893	5 00	
" 1894	5 00	
" 1895	25 00	
" 1896	55 00	
" 1897	115 00	
" 1898	1,825 00	
" 1899	15 00	
		$2,055 00
Initiation fees, members elected Oct. 20, 1898		270 00
Sale of Proceedings		54 75
Interest on bank deposit		11 72
Advertisements in Quarterly Proceedings		60 00
Total receipts		$2,451 47
Cash balance from last year		287 72
Total		$2,739 19

Expenditures.

Expense of 25th Annual Meeting	$	70 90
Report of 25th Annual Meeting		207 60
Report of Council Meeting, Oct. 19, 1897		32 50
Expense of Committee of Education		206 26
Expense of C. H. Nettleton, President for Telegrams, etc., 25th Annual Meeting		5 90
Publishing Proceedings, Vol. XIV		807 75
Distribution of Proceedings, Vol. XIV		81 00
Expense of Council Meeting, May 17, 1898		45 00
Report of Council Meeting, May 17, 1898		11 00
Salary of Secretary and Treasurer		600 00

R. R. Agent for 26th Annual Meeting	17 00
Subscriptions to publications	7 17
Binding old Gas Light Journals	20 75
Advance copies of Papers	48 75
Distributing advance copies	16 25
Circulars, Programs, etc., for 25th Annual Meeting	32 50
Membership Badges	98 50
Stationery, etc., as per vouchers and P. C. Book	24 26
Telegrams	9 15
Expressage	12 01
Office expenses	25 82
Postage stamps, stamped envelopes and registry	76 18
Sketch for Vol. XV	3 00
	$2,459 25
Net balance, per check-book $48 16	
Cash in hands of Treasurer 20 06	
Cash in Savings Bank 211 72	
	279 94
	$2,739 19

Respectfully submitted by

ALFRED E. FORSTALL, *Treasurer.*

NIAGARA FALLS, N. Y., October 18, 1898.

To the President and Members of the American Gas Light Association:

GENTLEMEN:—The undersigned members of your Finance Committee have duly examined the books, accounts and vouchers of the Treasurer of this Association for the year ending September 30, 1898, and have found the same to be correct.

ALEX. C. HUMPHREYS, *Chairman,*
GEO. G. RAMSDELL,
E. G. PRATT,
Finance Committee.

The Secretary read the following Membership Report for the year ending September 30, 1898, which was, on motion of Mr. White, received and placed on file.

Membership Report of Secretary for Year Ending September 30, 1898.

Honorary Members.

On roll October 1, 1897		7	
Elected October 20, 1897		2	
On roll September 30, 1898			9

Active Members.

On roll October 1, 1897		373	
Elected October 20, 1897		19	
Reinstated October 20, 1897		1	
		393	
Dropped November 5, 1898	6		
Failed to qualify	1		
Resigned during year	10		
Died during year	7		
		24	
On roll September 30, 1898			369

Associate Members.

On roll October 1, 1897		57	
Elected October 20, 1897		9	
		66	
Dropped November 5, 1897	1		
Resigned during year	2		
		3	
On roll September 30, 1898			63
Total membership September 30, 1897			441

Deceased.

Active member, Wm. L. Proctor, Ogdensburg, N. Y., November 17, 1897.

Active member, J. F. Rogers, Boston, Mass., December 18, 1897.

Active member, Geo. D. Cabot, Lawrence, Mass., January 18, 1898.

Active member, John Tracey, Poughkeepsie, N. Y., March 19, 1898.

Active member, Clefford L. Slade, Port Chester, N. Y., May 18, 1898.

Active member, Wm. Gardner, Pittsburg, Pa., August 5, 1898.

Also Fred W. Norton, whose death was recorded last year.

RESIGNED.

Active.

Augustus L. Allen	Poughkeepsie, N. Y.
William Anderson	East Boston, Mass.
C. B. Bailey	Washington, D. C.
H. N. Bigelow	Clinton, Mass.
John S. Chambers	Trenton, N. J.
J. L. Hallett	Cripple Creek, Col.
Chas. E. Judson	Chicago, Ill.
Thomas G. Lansden	Washington, D. C.
David Moore	Salem, Mass.
J. B. Smallwood	Baltimore, Md.

Associate.

S. H. Bingham	Chicago, Ill.
Harry DeB. Page	New York, N. Y.

DROPPED.

Active.

H. A. Atwood	Plymouth, Mass.
F. C. Blood	Ware, Mass.
W. E. Fullegar	Rutherford, N. J.
Wm. J. O'Brien	Philadelphia, Pa.
R. W. Pratt	Boston, Mass.
J. J. Russell	Colorado Springs, Col.

Associate.

Jerome B. Gray	Philadelphia, Pa.

Respectfully submitted by

ALFRED E. FORSTALL,

Secretary.

MONTCLAIR, N. J., Sept. 30, 1898.

THE PRESIDENT:—Next will be the report of the Committee on Education of which Mr. Clark is Chairman:

Mr. Clark read the following report:

To the American Gas Light Association:

GENTLEMEN:—Your Committee have to report as follows: During the class year, beginning December 1, 1897, there was issued to the students of the Class but one list of questions and answers. The Committee regret to have to report that, owing to press of other duties upon the members of the Committee, they were unable to carry the work of the Class beyond the issuing of this first series of questions and answers. Realizing that the continuation of the Class depends upon the securing for it the entire services of some one competent person, an effort has been made during the year to secure a fund for the employment of a suitable man for this work, and to insure the carrying on of the work during the next five years. A report of the success of this attempt will be made you by Mr. Alex. C. Humphreys, who is Chairman of the Committee appointed to make the effort to secure the funds referred to above.

The Class at the beginning of the year, December 1, 1897, numbered fifty-six. Those who answered the first list of questions, and who may properly be regarded as the members of the Class as at present existing, numbered fifty-nine.

There are eighteen applications on hand for membership for the year beginning December 1, 1898.

If the present members of the Class continue their membership, the Class at the beginning of the new year will number at least seventy-seven. It is probable that applications will come in between now and the 1st of December.

The interest in the work has continued and there were many expressions of regret from members of the Class when it was decided that, temporarily, the work would have to be abandoned. These men are now all anxiously awaiting your action. Upon the success of the plan referred to above, for securing the services of some person to carry on the work, will depend the opportunity of these men to continue a work from which they have been deriving great benefit and which they would be very sorry to lose. The benefits to the members of the Class and (your Committee

believe) to the American Gas Light Association are out of all proportion to the amount of money expended.

The expenditures for the Class for the year have been $100.71 or $1.70 per member per year.

WALTON CLARK, Chairman,
ALEX. C. HUMPHREYS,
GEO. G. RAMSDELL,
CHARLES H. NETTLETON,
ALFRED E. FORSTALL.

APPENDIX TO REPORT OF COMMITTEE ON EDUCATION.

CIRCULAR OF THE EDUCATION COMMITTEE TO MEMBERS OF THE PRACTICAL CLASS.

To the American Gas Light Association:

Enclosed herewith are the Committee's answers to the third list of questions, and the fourth and last list of questions of the 1897 session.

The Committee had hoped to be able to send out this list in August, but the late date of the receipt of the answers of many members of the Class has prevented.

The members who procrastinate in this work are doing an injury to themselves, and to others who are more prompt. The limit to the work possible for each session has been, and will be, determined solely by the industry of the members of the Class.

This 1897 session will end December 1st, next. All answers must be in by December 15. If you have not time to answer all the questions by that date, send in such answers as you can prepare in the time. Be sure to mail some answers at a date that will insure their being in possession of the Committee by December 15. That is two weeks later than the last day of the session, and will correspondingly delay the beginning of next year's work. The Committee hope for more prompt work on the part of the Class members who have caused the delays of this year.

Please note that all communications, answers to questions, etc., should be addressed to WALTON CLARK, 813 Drexel Building,

Philadelphia, Penna.; and the envelope containing such papers should have written on it "Educational Matter."

Also please note that answers should be plainly marked with the name of the writer, preferably on the first page.

The answers to the list of questions herewith enclosed must be in the hands of the Committee by the 15th of December.

November, 1897.

ANSWERS TO THIRD LIST OF QUESTIONS—1897—SUBMITTED TO THE PRACTICAL CLASS OF THE AMERICAN GAS LIGHT ASSOCIATION. THESE ANSWERS, WHERE IN QUOTATION MARKS, ARE TAKEN FROM THE ANSWERS SENT IN BY MEMBERS OF THE CLASS. IN OTHER CASES THE AUTHORITY IS GIVEN.

1. What is meant by the statement—"The tank was rendered with neat cement?"

Ans. To "render" a wall is to plaster directly upon the wall, without the use of lathing. Technically it is to apply one coat.

"Neat Cement" means cement unmixed; free from adulteration. Therefore, the statement "The tank was rendered with neat cement" means that the wall and bottom were covered with one coat of a mixture of cement and water, without sand, and applied directly to the face of the masonry.—*Com.*

2. Describe the preparation and use of cement mortar for brick work construction, with precautions to be observed to insure strength and uniformity.

Ans. A paste of good hydraulic cement hardens simultaneously and uniformly throughout the mass, and its strength is impaired by any addition of sand. The relative quantities of sand and cement depend somewhat upon the kind of work and upon the conditions of the ingredients when measured. For ordinary use, it is customary to add as much sand as is possible without making the mortar porous. The proportions may vary from one part of cement and two parts of sand to one part of the former and four of the latter.

The proportions of sand and cement are generally measured by volumes. In actual work the cement is usually delivered in barrels,

and consequently the most convenient unit for the cement is a commercial barrel, while it is most convenient to measure sand loose.

When the mortar is required in small quantities, as for use in ordinary masonry, it is mixed about as follows: about half the sand to be used in a batch of mortar is spread evenly over the bed of the mortar-box; and then the dry cement is spread evenly over the sand; and finally the remainder of the sand is spread on top. The sand and cement are then mixed with a hoe, or by turning and returning with a shovel. It is very important that the sand and cement be thoroughly mixed.

The dry mixture is then shoveled to one end of the box, and water is poured into the other end. An excess of water is better than a deficiency, particularly when a very energetic cement is used, as the capacity of this substance for solidifying water is great. The sand and cement are then drawn down with a hoe, small quantities at a time, and mixed with the water until enough has been added to make a good stiff mortar. This should be vigorously worked with a hoe for several minutes, to insure a good mixture. The mortar should then leave the hoe clean when drawn out of it, and very little should stick to the steel.

Hydraulic cements set better and attain a greater strength under water than in the open air; in the latter, owing to the evaporation of the water, the mortar is liable to dry instead of setting. This difference is very marked in hot, dry weather. If cement mortar is to be exposed to the air, it should be shielded from the direct rays of the sun, and kept moist by sprinkling or otherwise.

Grout is a thin or liquid mortar of lime or cement. The interior of a wall is sometimes laid up dry, and the grout, which is poured on top of the wall, is expected to find its way downwards and fill all voids, thus making a solid mass of the wall.

Grout should never be used when it can be avoided. If made thin, the water only slowly dries out of the wall; and if made thick, the grout fills only the upper portion of the wall. To get the greatest strength, the mortar should have only enough water to make a stiff paste—the less water the better. If the mortar is stiff, the brick or stone should be dampened before laying; else the brick will absorb the water from the mortar before it can set, and thus destroy the adhesion of the mortar.—*Baker's Treatise on Masonry Construction*.

3. Does coke deteriorate while stored? If so, why and how?

Ans. Coke when stored crumbles from exposure to rain and frost, and from the crushing effect of its own weight, to fine particles of less value. The fine particles or dust, are called "breeze" and for fuel purposes are of less value than the lumps.—*Com.*

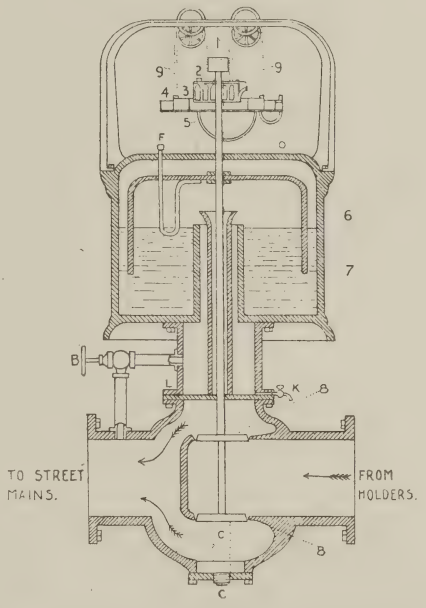
4. It is desired to put into service the full depth, regenerative retort bench let down in question 5, Series 2. Describe the process up to and including the drawing of the first charge burned off.

Ans. Draw the cold coke from the retorts. Patch the retorts if necessary. Clean out furnace and flues. Close tightly all secondary air-flues and sight holes. Open primary air-flues. Start a small coke fire on the grate. Replace bridge-pipe covers. Gradually increase the fire as the bench heats. Have the clinkering door partly open, that air may enter above the fire and burn the carbonic oxide within the furnace. Gradually increase the fire, and the opening of the main damper, until the combustion chamber and lower retorts are at a dull red heat. Then fill the furnace, close the door, turn water on the water grate, and watch for the appearance of a blue flame at the openings leading from the furnace to the combustion chamber. When this appears open the secondary air-flues gradually until the flame has shortened, and almost disappeared. The setting will now safely and rapidly come to a working heat. Charge the retorts as soon as they are all at a dull red. Draw the first charge when it is burned out. Begin regular charges when the retort is at a proper working heat. Close the main damper as the heat increases.—*Com.*

5. Describe the principle and action of some form of gas governor.

Ans. An automatic gas governor is one that will automatically establish and maintain predetermined pressures. The old style of balanced governor is capable of changing the volume of gas sent out while maintaining a uniform pressure at its outlet. Any desired change in the pressure, with this style of governor, is effected by adding or removing weights by hand. A perfect and automatic governor, for use in maintaining the supply of gas to a system of street mains must change volume and pressure together, without manipulation, the pressure being maintained always somewhat in proportion to the volume of gas going out.

One form of automatic governor in successful operation is shown in the accompanying cut. It consists of a bell 6, floating in a tank, 7, its interior being supplied with gas through pipe and valve B, connected with the *outlet* of the governor, and subject to the pressure on the street mains at the governor outlet. When the bell is floating with a certain pressure in the street mains, it can be readily seen that as long as this pressure is furnished there will be no tendency on the part of the bell 6 to change its position; but if through an increased consumption on the main, the pressure in the main is reduced, the pressure in the pipe B and under the bell 6 will be reduced, and the bell will tend to fall, giving more opening to the valves 8, in the valve-chamber of the governor, and permitting more gas to pass. So far, the action of the automatic governor is like that of an ordinary governor. The automatic governor differs from the ordinary governor in, that with this change in the position of the bell 6, comes a change in the position of the weight balancing the gas pressure under the bell. This change is made by an ingenious contrivance, as shown in the cut. 3 is an annular ring containing mercury, and connected by means of the rubber tube 5, with another annular ring 2, which also contains mercury. But the ring 2 is rigidly attached to the valve-rod connected with the valves 8, and any increase in the weight of 2 tends to depress the bell and the valve-rod, giving more opening to the valve; whereas 3 is connected to the valve-rod by means of chain or wire 9 passing over pulleys. Any increase in the weight of 3, therefore, tends to raise the valve-rod, the bell and the valves. If now there be a transfer of mercury, through the tube 5, from the annular ring 2 to the annular ring 3, the annular ring 3 will tend to



fall, raising the annular ring 2, and the valve-rod, bell and valve. If, on the contrary, there be a transfer of mercury from the annular ring 3 to the annular ring 2, there will be an addition of weight to the valve-rod, and it and the bell and the valves will tend to fall, and the valves to open. The level of the mercury in 2 and 3 will remain always the same—this for the reason that 2 and 3 are connected by a rubber tube. When, then, the pressure has fallen in the street mains, and therefore, under the bell, and the bell sinks, giving more opening to the valves 8, the ring 2 decends with the bell, the ring 3 is raised, because the wire or chain 9, passing over the pulleys, must follow the action of the ring 2, raising the ring 3, and causing some of the mercury to flow from it into the ring 2. We have, therefore, due to the reduction of pressure in the street mains, an increased opening on the valve, and an increase in the weight tending to hold the valve open, which means an increase of pressure. If, now, from the reduction in the consumption of gas, the original pressure in the street mains is restored, there will be an increase in the pressure under the bell 6, which will give it a tendency to rise. It will carry with it the ring 2, depressing the ring 3, and there will be a flow of mercury from the ring 2 into the ring 3. At the same time the valve will partly close and there will be a restoration of the conditions existing before the governor came into action.

The cup 1 is intended to receive weights used in adjusting the governor to the conditions under which it is to operate. These conditions once being established, and the governor being arranged to meet them, it requires no further attention, except to keep it clean and oiled. This governor can be so set that it will, for any given fall of pressure in the street mains, give a predetermined opening of the valves 8, and a predetermined pressure at the outlet of the governor, all within the limits permitted by the pressures thrown by the holders.

A feature of this governor is the provision made for its adjustment to meet the different conditions existing in works of the same size.

To illustrate this: We will take two works, each sending out 150,000 cubic feet per day, the holder pressure being $\frac{80}{10}$, and the maximum send out being 25,000 cubic feet per hour. For one of the works, say at "Gastown," the condition of the mains is such

that a maximum pressure of only $\frac{20}{10}$ is required, and a day pressure of $\frac{10}{10}$ is sufficient.

For the other works, say at "Lightville," the condition of the mains and services is such that a day pressure of $\frac{18}{10}$ and a maximum pressure of $\frac{20}{10}$ is required; the margin of difference between holder and maximum pressure in this case being only $\frac{2}{10}$ against a difference at the other works of $\frac{10}{10}$. In each case the same volume of gas passes through the governor valve in the same space of time. In the case of "Gastown" the valve would be open about 1 inch, and of "Lightville" 3 inches, or more.

To adapt the governor to meet such variable requirements and conditions, a series of three compartments or concentric vessels (2) are arranged around and attached to the valve stem, each of a different capacity and so arranged that by adjusting to use any one, or any two, or all three at once, a given quantity of mercury can be made to form a column of mercury of any one of seven different heights. This enables the superintendent to secure a transfer of any desired quantity of mercury on any stroke of the valve.

The volume of mercury transferred for any given movement of the valve, valve stem and vessel 2, is increased by increasing the area of vessel 2. This vessel is so arranged that it may have any one of seven areas, as desired. The area to be used depends upon the conditions under which the governor must work.

In setting or adjusting the governor to meet the requirements of a works, the superintendent determines what pressure he desires at the lowest point of the district. He may desire to maintain at this point, say 1-inch pressure. He may find that to do this a day pressure of $\frac{15}{10}$, and a night pressure of $\frac{25}{10}$ must be maintained at the works; a difference of $\frac{10}{10}$. Six ounces of mercury for each tenth (or 60 ounces) is put into ring 3. The governor is then weighted (in cup 1) to carry the day pressure of $\frac{15}{10}$. When the consumption increases, the valves at once open, as above; this lowers vessel 2 and the mercury flows from 3 into 2, the result being to increase the weight on one side and diminish it on the other. Say the valve has opened in response to demand enough to transfer 6 ounces; this would equal placing 12 ounces on the valve stem, and the bell or float having this extra weight, the pressure is increased correspondingly. When the maximum volume is reached all of the mercury is in vessel 2, the full pressure of $\frac{25}{10}$ is on.

6. What is meant by the statement—" The specific heat of a certain substance is .750, or is three-quarters that of water ? "

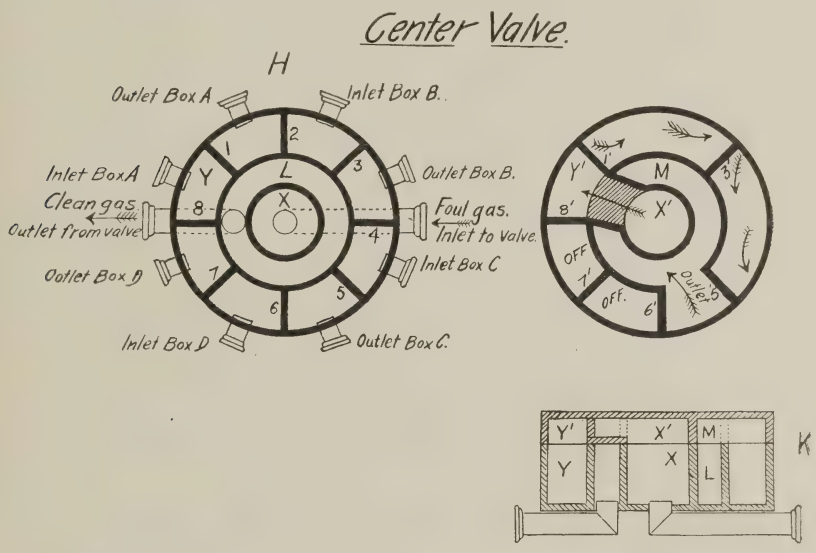
(The Committee desire to emphasize the importance of a thorough understanding of the laws involved in the solution of heat problems. Any student who has not an understanding of Problem 7, Series 1, and of Problem 7, Series 2, is recommended to give them further study.)

Ans. The statement " The specific heat of a certain substance is .750, or is three-quarters that of water " means that the amount of heat, or of heating power, required to raise the temperature of the substance one degree is 75 per cent. of that required to raise the temperature of a body of pure water of the same weight from 39.1° to 40.1° Fahr.—*Com.*

7. Make a sketch of a dry centre valve for four purifying boxes, built to put three in action at one time. Show the divisions of the seat and cover, and describe the action of the apparatus.

Ans. The centre valve is a device whereby a set of four purifying boxes may be so operated that one box is thrown out of use for cleaning,—the other three being in use, and the gas passing through them in sequence. The position of the cover on the body of the valve determines which box is out of use. The blue-print shows the construction of the valve, H being the body of the valve, I the cover, and K a vertical section through the cover and the body, showing the cover in place. The body of the valve has a solid bottom, and when the cover is removed is open at the top. The cover, which revolves on the body of the valve, has a solid top, but is open at the bottom, except for that part shown in shaded lines on the section I. The blue-print shows the cover as it would appear if the top plate were removed. If the cover I were placed over the body of the valve H, each in the positions as shown on the blue-print, the space marked in the cover Y^1 would exactly correspond with the space Y in the body of the valve. The course of the gas would then be as follows: Entering the inlet to the valve, it would come into the centre space X, in the body of the valve. Having no other outlet, it would rise into X^1 of the cover. Its only outlet thence would be to Y^1 of the cover, thence to Y of the body of the valve, and thence through the inlet into box A. Passing through box A, to its outlet, it would find its only possibility of escape to be into the space 1 of

the body of the valve. The partition between Y^1 and 1^1 of the cover of the valve would be over the partition between Y and 1 of the body of the valve. The gas would, therefore, be compelled to rise from 1 of the body of the valve into space 1^1 of the cover of the valve. It could then, in the cover of the valve, pass over the partition between spaces 1 and 2, in the body of the valve, and down into space 2 of the body of the valve, which is connected with the inlet of box B. The partition between 1^1 and 3^1 of the cover would be over the partition between spaces 2 and 3 of the body of the valve. The gas then returning from box B, through its outlet into space 3 of the body of the valve,



would find its only direction of further progress to be up into the cover of the valve into space 3^1, over the partition between spaces 3 and 4 of the body of the valve, and down into space 4 of the body of the valve, which is connected to the inlet of box C. Passing through box C and out of its outlet into space 5 of the body of the valve, it finds its only direction of further progress to be up into space 5^1 of the cover of the valve. But space 5^1 of the cover of the valve is shut off by the position of the cover on the body of the valve, from space 6 of the body of the valve, which is connected with the inlet of box D. Therefore, the gas cannot reach the inlet of box D. But space 5^1 of the cover of the valve is

open to space M of the cover of the valve, which in turn is open to space L of the body of the valve (spaces M and L are annular rings surrounding the spaces X^1 and X). The gas then would pass from space M of the cover down into space L of the body of the valve. Space L of the body of the valve is directly connected with the clean gas outlet from the valve, and the gas, therefore, would pass, having no other means of egress, through this outlet

A little study of the blue-print will show that if the cover were revolved on the body of the valve until space Y^1 of the cover corresponded with space 2 of the body of the valve, which is the inlet of box B, box B would first receive the gas coming from the valve, and box D would be thrown into the series,—box A being shut off. In this position of the valve, spaces 6^1 and 7^1 of the cover would be over spaces Y and 1 of the body of the valve.

If the student will carefully cut out from the diagram of the cover the spaces 1^1, 3^1, 5^1, 6^1, 7^1, Y^1, X^1, and M, he will have left the lines showing the walls of the different compartments of the valve, and that part of the bottom of the cover which is solid, namely, the shaded part. If he will then apply this to the cut of the body of the valve, making the circular lines of one correspond with the circular lines of the other, he will be able, by moving the diagram of the cover, to get a better idea of the way in which the valve works, and of the positions which the cover must occupy in order to put one or another of the boxes off for cleaning.—*Com.*

8. What is the common method of manufacturing sulphate of ammonia; and what are the chemical reactions that occur in the process?

Ans. The manufacture of sulphate of ammonia depends on the chemical facts that all compounds of ammonia are decomposed when heated with an alkali, free ammonia being liberated, and that sulphuric acid combines with ammonia to form sulphate of ammonia.

The chemical changes involved may be represented as follows:

$$\underset{\text{Carbonate of ammonia}}{(NH_4)_2CO_3} + \underset{\text{Hydrate of lime}}{Ca(OH)_2} = \underset{\text{Carbonate of lime}}{CaCO_3} + \underset{\text{Water}}{2H_2O} + \underset{\text{Ammonia}}{2NH_3}$$

AND

$$\underset{\text{Ammonia}}{2NH_3} + \underset{\text{Sulphuric acid}}{H_2SO_4} = \underset{\text{Sulphate of ammonia}}{(NH_4)_2SO_4}$$

As the operation is ordinarily conducted, the gas liquor is pumped into a still, and heated by admitting live steam at the bottom of

the still. On heating the mixture, free ammonia is disengaged, together with large volumes of H_2S and other foul gases. When all, or nearly all the free ammonia and the volatile compounds of ammonia have been driven from the liquor, cream of lime is added to free the ammonia from the ammonia salts held in solution in the liquor. The acids of the salts combine with the lime, and the ammonia is liberated. The lime salts remain in the liquor.

The ammonia and other gases leaving the still pass to a "saturator" containing sulphuric acid, through which they bubble. The ammonia is retained by the acid, forming sulphate of ammonia, which crystallizes and settles out from the solution and is ladled out and dried.

The foul gases after leaving the saturator are either burned, or absorbed by oxide of iron in order to prevent a nuisance.

9. What is "coal liming?" Give its purpose, and its effect on the impurities in the gas, and on the residuals produced.

Ans. By "coal liming" is meant the mixing of a certain amount of slaked and powdered lime—usually about 3 per cent. by weight—with the coal before it is charged into the retorts. Its purpose is to reduce the amount of work on the purifiers by retaining a portion of the sulphur in the retorts in combination with the lime, and also to increase the yield of ammonia. It has been stated by good authority as the result of experiment, that the life of the purifying material is doubled, the amount of ammonia in the gas greatly increased, and the quantities of C O and CO_2 notably diminished. The appearance of the coke, however, is marred by white specks of lime, the amount of clinker is increased, and the quality of the coke impaired by the increased content of sulphur.

The Committee are not aware that the "coal liming process" is in use at this date in any gas works.

10. What is a paint?

What is a varnish?

Ans. Technically, a paint is a mechanical mixture of a liquid (generally linseed oil, with turpentine, known as the "vehicle") and a finely divided solid, (as white lead or red oxide of iron, known as the pigment or coloring substance) sufficiently fluid to be applicable to surfaces with a brush, and having the property of drying

upon surfaces coated with it to a hard, continuous, tenacious and somewhat elastic skin, protecting them from air and moisture, and giving them the color of the pigment used.

Paint acts, therefore, as a preservative and a decorative covering.

The pigment in its dry state is also called "paint."

An oil, or mixture of oils, to be valuable in a paint, should have the property of drying when applied to a surface, to a hard, lustrous and tenacious skin.

Water is sometimes used as the vehicle of a paint. A simple mixture of water and a pigment does not adhere to surfaces with the tenacity of oil paints.

A varnish is a solution of a resinous substance (as amber, copal, shellac, etc.) in an oil or spirit (as linseed oil, turpentine, alcohol, or methylated spirit) which will dry and harden, and remain transparent. When the solvent is an oil, the varnish is known as an "oil varnish" When the solvent is a spirit, the varnish is known as a "spirit varnish." Varnishes, when applied to wood, metal or other surfaces, dry and form a hard, smooth, transparent, and somewhat elastic surface, protecting the material covered from the air and moisture. Varnishes may be colored by the addition of substances that give color without making the mixture opaque.—*Com.*

11. What is oxidation?

" " combustion?

Ans. Chemically considered, oxidation and combustion are identical, being in each case the combination of oxygen with another element or elements.

When the union with oxygen takes place rapidly with the production of light and heat, the process is called "combustion." This is seen in the burning of coal or wood.

On the other hand, "Oxidation" is accomplished slowly and gradually, and usually without any perceptible increase in temperature, as in the rusting of iron.

Note by Com.—Combustion may be scientifically defined as a union of any two or more elements with evolution of light and heat, but in general the word is defined as in the above answer.

12. Why are scrubbers for the removal of ammonia filled with coke or slats?

Ans. Ammonia is removed from gas by means of the affinity the water has for ammonia. The gas is brought in contact with wetted surfaces of wood, coke or other material in cylindrical vessels called scrubbers. The greater the amount of wetted surface with which the gas comes in contact, the more efficient is the scrubber. It is important, therefore, that the filling material for scrubbers should present large surfaces to the gas, and should be of such a form, and so arranged, that the gas in passing through it would be broken up into many small streams. Coke, or wooden slats arranged in grids, answer these conditions, and therefore are the materials generally used in filling scrubbers for the removal of ammonia.—*Com.*

13 Describe the cleaning of a water gas wash-box, including the precautions to be observed.

Ans. To insure safety the wash-box and connections must be thoroughly ventilated.

There are two arrangements of wash-box in water gas apparatus. In one the take-off from the wash-box is on top, and in the other it is on the side, and connects directly with the scrubber.

The connection from the gas outlet on top of the super-heater to the wash-box varies in different forms of water gas apparatus. In most cases there is a lid on top of what is known as the oil heater connection, which can be opened to clean the oil heater.

Where no oil heater is used, the take-off connection from the super-heater has a hand-hole cross at the top of the super-heater, connecting the vertical riser from the wash-box to the outlet branch on the super-heater.

Where the wash-box has a take-off on top, there is a valve between the wash-box and the scrubber, which can be closed and thus shut off communication between the wash-box and scrubber. In this case, first open either the lid on top of the oil heater, or, in case there is no oil heater, the hand-hole on the cross; then shut off the overflow from the wash-box to the seal pot, open the hand-hole on top of the wash-box, and fill the wash-box with water. When the wash-box has been filled, draw off the water, open the hand-hole or man-hole on side of wash-box, and remove the tar, etc.

In case there is no valve between the wash-box and the scrubber, but the scrubber and wash-box are joined together by the side

outlet on the wash-box, the first thing to be done is to close off the overflow pipe from the scrubber to the seal pot. Then open the man-hole on top of the scrubber, and then the lower man-hole on the side of the scrubber. Fill the wash-box with water as described above.

The only difference in the two methods is that in one case you must thoroughly ventilate the scrubber in the manner described. *In any case provide that no fire comes near the wash-box or connections while the wash-box or connections are open. Do not use a light about the work.—Com.*

14. If you have no knowledge of water gas apparatus, omit question 13, and describe the cleaning of a badly stopped standpipe.

Ans. A stand-pipe may be stopped with soft pitch, with hard pitch, with lamp-black, or with a mixture of two or all of these substances. If a pipe is so stopped that it cannot be cleared with an auger inserted from the mouthpiece, it will be necessary to make an attempt to clean it from the upper end of the pipe, which is opened by removing the cap. If it is possible to push a rod, either cold or brought to a red heat, through the material, thus making a small opening, the pipe may perhaps be thereafter cleared by building a small wood fire in the mouthpiece. The draft which will be established through the opening forced through the stoppage as above, will draw the heat from the burning wood through the material causing the stoppage, and may soften it so that it may be removed with an auger or ring tool. If this fails, or if it is not possible readily to force the stoppage with a red hot iron bar, an iron basket may be attached to the outside of the pipe, at or near the stoppage, and the stoppage melted out by the heat from a fire in the basket. Any stoppage that cannot be removed by these methods is hard carbon, or coked pitch, and can probably only be removed by burning out. This may be accomplished by forcing a small hole, as above, and building a fire in the mouthpiece, or by the removal of the standpipe, and building a fire around it in the yard.

Ordinarily, the stoppage, however complete, may be removed by the use of the red hot bar and the fire in the mouthpiece; the great majority of stoppages that cannot in this way be removed without difficulty, may be softened by the use of the iron

basket and fire attached to the outside of the pipe, at the point of stoppage.

The ascension pipes should be cleaned each time the retort is scurfed, for the scurfing will loosen the pitch or carbon so that it may be easily removed by a chisel bar carefully used. A test ring should be passed through the pipe one-quarter inch less in diameter than the pipe, before it is put back into use.—*Com.*

FOURTH SERIES OF QUESTIONS FOR THE PRACTICAL CLASS OF THE AMERICAN GAS LIGHT ASSOCIATION—1897.

1. What kind of bricks are best for holder tank work?
2. What are the characteristics of a good building sand?
3. Describe the proper method of laying bricks in holder tank work.
4. Describe, with sketches, a full set of retort house firing and cleaning tools. Do not include in your answer tools for repairing, or coal and coke wagons.
5. Describe, with a sketch, the making of a 2-inch service connection to a 6-inch main.
6. Is the specific heat of a gas, or vapor, at *constant pressure;* that is, when free to expand, as gas in a gas holder; the same, or more or less, than the specific heat of the same gas or vapor at *constant volume;* that is, when confined, as steam in a boiler? Why? See answer to Question 6, Series 3.
7. What is a "by-pass"? Give a sketch of by-pass as connected to some part of a gas work's apparatus, and describe its use and purpose.
8. Assume that in burning off 2240 pounds of a certain soft coal in gas retorts, six pounds of ammonia gas (NH_3) is liberated and collected in the ammoniacal liquor; that 5 per cent. is lost in the transportation and working of the liquor; that it is made into sulphate of ammonia. How much dry sulphate of ammonia will it yield, and how much pure sulphuric acid (H_2SO_4) will be used in the operation, assuming no waste of acid?

Give your calculations.

9. Describe the painting of a gas holder, giving each detail of the work, and including the preparation of the iron by removal of old paint and rust.

10. Name some useful purpose or purposes to which tar (coal gas or water gas) can be applied around gas works, and describe the method of preparation and application.

11. A pound of a certain coal contains 14 ounces of carbon and one-half ounce hydrogen. What would be the product of its complete combustion, and how much would each product weigh? How many "heat units" would be developed by the complete combustion of this carbon and hydrogen?

Give your calculations.

12. What is the specific heat of H?

" " " " CO?

" " " " CO_2?

" " " " N?

" " " " O?

" " " " Steam?

Give specific heat of each at *constant pressure.*

It will be evident that problems in gas manufacture and in combustion deal with gases free to expand or contract with changes of temperature, and therefore, that they have to do with gases and vapors at constant pressure.

ANSWERS TO FOURTH LIST OF QUESTIONS – 1897 – SUBMITTED TO THE EDUCATIONAL CLASS OF THE AMERICAN GAS LIGHT ASSOCIATION. THE AUTHORITY FOR THE ANSWER IS GIVEN IN EACH CASE.

1. What kind of bricks are best for holder tank work?

Ans. Baker's Treatise on Masonry Construction, page 37, contains the following paragraph: "Requisites for Good Brick. 1. A good brick should have plane faces, parallel sides, and sharp edges and angles. 2. It should be of fine, compact uniform texture; should be quite hard, and should give a clear ringing sound when struck a sharp blow. 3. It should not absorb more than one-tenth of its weight of water. 4. Its specific gravity should be two or

more. 5. The crushing strength of half brick, when ground flat and pressed between thick metal plates, should be at least 7,000 pounds per square inch."

For holder tank construction it is especially important that the brick should be strong, hard and dense. While all twisted or distorted brick should be refused from tank construction, it is not essential that the faces should be exactly parallel. A slight bulge or belly to the larger surfaces of the brick is not a fault. Such a brick when shoved into place, as described in answer to Question 3. is much more certain to force out all air and insure a well filled joint than a brick that is hollow on the faces—or, even, than a brick that is exactly flat, with parallel faces.

Brick for a holder tank should not be bought on a sample. The k ln from which a brick is to be purchased should be examined, if possible, and if not, the bricks should be seen in large numbers before purchase is made.

Some ho'der tanks depend for their tightness upon a filling of clay under the bottom and back of the sides, the brick being intended to give form to the tank, support the puddle and guide the holder. Such a tank may appropriately be made of porous brick, provided the brick has sufficient strength, for there is no objection to the water percolating through the brick and coming in contact with the clay outside. In fact, it is important, with such tanks, that this should be the condition. Where. however, the tank depends for its tightness upon the brick work, the brick should be dense.—*Com.*

2. What are the characteristics of a good building sand?

Ans. "Sand is mixed with lime or cement to reduce the cost of the mortar, and is added to lime also to prevent the cracking which would occur if lime were used alone. Any material may be used to dilute the mortar, provided it has no effect upon the durability of the cementing material, and is not itself liable to decay. Burnt clay, powdered brick, slag or coal cinders may be used. Of course, the strength of the mortar decreases with the amount of dilution.

"It is usually specified that sand for mortar should be clean and sharp, and free from pebbles.

"Although it is customary to require that only clean sand shall be used in mixing mortar, a small amount of finely powdered, inert

diluting material, as clay for example, will not materially decrease the strength of the mortar. Clay, when dissolved or finely pulverized, consists of an almost impalpable powder, and, when mixed with the sand, its particles occupy the interstices between the particles of cement and sand, and are also completely enveloped by the cementing paste.

"The cleanness of sand may be tested by rubbing a little of the dry sand in the palm of the hand, and after throwing it out noticing the amount of dust left on the hand. The cleanness of sand may also be judged by pressing it together between the fingers while it is damp; if the sand is clean, it will not stick together, but immediately fall apart when the pressure is removed. As a rule, reasonably clean sand can be had without any extra trouble or expense.

"Sharp sand, that is, sand with angular grains, is much better than that with rounded grains, although it is often difficult to obtain. The sharpness of sand can be determined approximately by rubbing a few grains in the hand, or by crushing it near the ear and noting if a grating sound is produced; but an examination through a small lens is better. The requirement that "the sand shall be sharp" is practically a dead letter in most specifications.

"Sand should be screened to remove the pebbles, the fineness of the screen depending upon the kind of work in which the mortar is to be used. Every particle of the sand or "aggregate" should be completely covered with the cement or "matrix," and since, when the grains in a given volume are small, the magnitude of the total surface to be covered is greater than when the grains are large, it follows that fine sand requires a larger proportion of cement than coarse sand. Any specification or plan contemplating the use of coarse sand must therefore be altered, if fine sand alone is used, else the quality of the mortar will be impaired. The best sand is that in which the grains are of different sizes. The more uneven the sizes, the smaller the voids, and hence less cement is required. The voids of ordinary sand average from 0.3 to 0.5 of the volume." BAKER.

3. Describe the proper method of laying bricks in holder tank work.

Ans. Baker's Treatise on Masonry Construction gives the following instruction:

"Brick should not be merely *laid*, but every one should be rubbed and pressed down in such a manner as to force the mortar into the pores of the bricks and produce the maximum adhesion; with quick-setting cement this is still more important than with lime mortar. For the best work it is specified that the brick shall be laid with a "shove joint;" that is, that the brick shall first be laid so as to project over the one below, and be pressed into the mortar and then be shoved into its final position.

"Since brick have great avidity for water, it is best to dampen them before laying. If the mortar is stiff and the brick dry, the latter absorb the water so rapidly that the mortar does not set properly, and will crumble in the fingers when dry. Neglect in this particular is the cause of most of the failures of brick work. * * * * Wetting the brick before laying will also remove the dust from the surface, which otherwise would prevent perfect adhesion."

There is among constructors a difference of opinion as to how the bricks should be put in the wall. The following is from a man who has had considerable experience in tank work, and whose tanks have been tight:

"The bricklayer should put only enough mortar on the wall to embed one brick, place the brick in the mortar, then give it a sliding motion in two directions to fill the joints on one end and on one side, and to expel the air from under the brick. The mortar should then be cut off the top and returned to the board.

"It is impossible to accurately describe how to push brick; the only way is to get a brick mason that can and will do this kind of work, and have him instruct each mason that is taken on the job how the work is to be done."

An advocate of grouting, who has been perfectly successful in tank work, writes as follows:

"The thickness of joint being decided upon, the outside and inside circle should be laid up five courses, making a trough for filling in. Spread thick mortar in the bottom of this trough, and lay the brick in this mortar, care being taken that the brick shall be put down in such a manner as to drive all the air out as they fall into place. This makes a full joint under the brick. Then grout with mortar to be thrown over the tops of these brick from a bucket in the same manner as coke is quenched, the mason using

his trowel to fill in any joints that are not filled by spreading the mortar in this way. On this layer of bricks spread another layer of stiff mortar and lay another course of brick, grouting in these as in the former case. Care should be taken to arrange headers and stretchers, so there will be a good bond.

"By pursuing this method a fair mason can lay from 1800 to 2200 brick per day; 2100 to 2200 brick were laid per day, per mason, under my supervision. The brick for the inside and outside circle should be wetted with a hose. The brick for filling in should be thoroughly wetted, and I would advise having a number of tubs placed at intervals on the scaffold, and the brick thoroughly soaked with water in these tubs before being put in the wall; in fact, the brick should be taken from the tubs and placed in the wall without giving them any time to dry."

There can be no doubt that entirely satisfactory tanks have been built by each method. It is probably equally true that a mason can lay from 200 to 400 more bricks a day by adopting the second, or grouting method. It is also probably true that more close supervision is required to obtain good work with the grouting system.—*Com.*

4. Describe, with sketches, a full set of retort house firing and cleaning tools. Do not include in your answer tools for repairing, or coal and coke wagons.

Ans.

FURNACE TOOLS.

Secondary Bars.—Made of 2½-inch x ⅝-inch refined iron, welded to a piece of 1⅛-inch round iron, with a 2-inch head for driving with a sledge hammer.

These bars are driven through the fire above the clinker line, and hold up the fuel while the ashes and clinker are removed from the lower part of the furnace.

Cleaning Rake for Primary Air Ports into Furnace.—Made of ½-inch round iron, with an eye handle and a small rake end at right angles to main portion of handle. One right and one left for the two sides of the furnace.

Used for raking out the ashes that get into the air ports during the cleaning of the fire.

Stoking Rake.—Made of a piece of 3-inch x ¾-inch flat iron, 5 inches long, welded in centre at right angles to a round rod,

tapering from 1⅛ inches where welded to the flat iron to ⅞-inch at the eye handle, and 10 feet 6 inches long over all.

Used to push the coke well to the back of the furnace, immediately before and during the stoking draw, to secure an even fuel bed throughout the whole depth of the furnace.

Furnace Shute.—Made of No. 11 B. W. G. iron, bent to proper shape, bound with ¼-inch x 1¼-inch flat iron, and provided with legs of ½-inch x 1½-inch flat iron.

It is used to catch the coke as it is drawn from the top and middle retorts on one side of a bench of sixes and cause it to slide in the charging opening of the furnace into which the lower part of the shute fits, the stoking rake being used to push the coke into the back of the furnace from this opening.

Retort Tools.

Drawing Rake.—Head made of ¾-inch x 3-inch flat iron, 13 inches long, welded to handle at a point 1½ inches from one end. Handle 1¼ inches round iron, for 18 inches from head, 1-inch round for 8 feet more, and ⅞-inch round for rest of the 14 feet 6 inches length. Eye on end of handle.

Used for drawing the coke out of retorts.

Carrying Stick.—Made of ⅞-inch round machine steel, 3 feet 6 inches long over all, and with proper curve in middle to fit the bottom of the scoop.

Used for lifting and carrying front end of scoop when charging the retorts.

Scoops.—Made of No. 14 B. W. G. soft steel, cut to size sheets needed (15 inches x 105 inches), and pressed into shape in a press made of three 6-inch pipes, with necessary screw arrangements. Reinforced for 16 inches at head with a piece taken from an old scoop. Strip of ⅜-inch x 1¼-inch ⊃ iron riveted along outside at bottom to stiffen it. Head made of ½-inch soft steel, bent to proper shape on anvil, with a strengthening piece of ¾-inch steel put on around opening for handle. Handle of 1½-inch round steel, upset on inside, and welded outside to a piece of round iron of same size tapering to ⅞-inch in 2 feet. Cross-bar of handle ⅞-inch round, and 2 feet over all.

Used for charging coal into the retorts.

"*Tippler.*"—Made of 7/8-inch round iron, with eye handle and short hook on other end tapered down to 5/8-inch at point.

Used on charging floor for slacking off levers, opening lids of mouthpieces, raising the flaps covering the openings through the floor into cellar, and every other purpose requiring the use of a hook.

Leveling Rake.—Made of a piece of 3/4-inch x 3 1/2-inch flat iron, cut to a semi-circle of 7 inches in diameter, welded at right angles to a handle 6 feet long, the first 12 inches of which is 1-inch round iron and the rest 3/4-inch round, with an eye on end.

Used for leveling back the coal from mouthpiece into retort after the charge, also for closing the lid and pushing in the lever.

Mouthpiece Bar.—Made of 5/8-inch round iron, with eye handle and a chisel end of steel, dressed to an edge and tempered, 4 feet long.

Used to chip off the tar and pitch that accumulate on inside of mouthpiece lids.

Buck.—Made of two 1-inch Ells, with side outlets, and the necessary 1-inch pipe to form four legs and a cross-piece.

Used to support the drawing-rake and raise it above the bottom of the retort when drawing the bottom retorts, thus saving the fireman from so much stooping in handling the rake on these retorts.

Stand-pipe Tools.

Cutter Head.—Forged from 2-inch x 2-inch iron, slotted and drilled, as shown in drawing, for the reception and fastening of cutting tool, and welded to a piece of 1-inch pipe of sufficient length to allow the cutter to reach well into the bend of the stand-pipes from the bottom retorts. Provided with an eye handle parallel to slot in head, so that the direction of the cutter is always known. One of these heads is also welded to a curved handle of 5/8-inch and 3/4-inch round iron, similar to the auger handles. The cutting tools for use in these heads are made of 5/8-inch x 2 1/2-inch steel, tempered on edges of the slope, shown on drawing, in sizes increasing by 1/2-inch from 4 inches up to 5 1/2 inches in extreme width.

This tool is for use in case the carbon in a pipe is too hard to be cut away with other tools. By its use vertical grooves are cut in

the carbon, as shown on the drawing, almost out to the iron. Then the pipe is fired hard for an hour or so—that is, the flame from wood burnt in the retort is drawn up through the pipe, causing the carbon to crack away from the iron, so that it can be broken off in great lumps by means of the "Star," thus cleaning the pipe quickly, even when badly stopped, owing to previous imperfect cleaning. The whole operation can be performed without the excessive jarring and consequent loosening of joints that is necessary in doing the same work with an auger, with the further advantage that stand-pipes that cannot be cleaned with an auger are amenable to this treatment.

Star.—Made from a piece of ½-inch steel plate, cut to a circle of the proper diameter, the teeth then being cut out, as shown, and tempered. It is not necessary to make this double, though it is shown so on the drawing. This is fastened to the handle of 1-inch pipe, the length of which is determined by that of the longest stand-pipe. In two sizes for use for the top of pipes; also one provided with an auger-handle for use from the charging floor.

This tool is used as the first and only tool in cleaning pipes from hard stoppages that are not bad, and to follow the cutter in the case of pipes in which the carbon has been allowed to grow thick. The largest size is of such a diameter that when it has cut its way down a pipe the ring will follow easily.

Ring.—Made of ⅜-inch x 2½-inch steel, drawn to an edge, as shown on drawing. To it are riveted four ⅝-inch rods, welded together at their other ends, the single rod thus formed being welded to a piece of ¾-inch pipe, long enough to allow the ring to drop to the bottom of the longest stand-pipe.

This ring is used merely to detect the presence of any lumps that the *Star* may have slipped by, and is not used to cut away obstructions of any size. It is made from ¼-inch to ⅜-inch less in diameter than the pipes on which it is to be used

Augers.—Made from steel blanks $\frac{3}{16}$-inch thick, and of shape and size shown on the drawing. Welded to rods 11 feet long, 7 feet at handle end of which is ¾-inch round and the rest ⅝-inch round iron. These rods have eye handles and are curved, as shown. The auger heads are given at least one full turn, and preferably more.

The augers are used to clean the lower portion of the stand-pipe at each draw. Similar heads are fixed on pipe handles for use in cleaning the pipe from above in case of a lamp-black or other soft stoppage.

Basket.—It sometimes happens that a pipe is allowed to run so long, or is so handled when the cleaning is begun, that it becomes completely choked up with carbon so hard that it is almost impossible to drive even a pointed bar through it. It is for such cases that this basket is useful. It is made of a piece of perforated iron, cut from a sheet discarded from a rotary coke screen; is open on one side where it abuts against the front wall of the stack, and the bottom has an opening cut far enough back to take in the stand-pipe. A pair of tongs with clamping ring, clutches the stand-pipe and supports the Basket at the proper height.

Its use is as follows: In the case described above, the obstruction is located and the point marked on the outside of the pipe. The tongs are then clamped on at the right place, the basket hoisted up and placed upon them, encircling the pipe and touching the front wall of the stack. A wood fire is started in the basket and kept up until the heat softens the obstruction sufficiently to allow a fair sized opening to be made through it, when it is permitted to die out and the pipe is burnt clean in the regular way.

(For drawings see Proceedings, Vol. XII, No. 3, page 192.)

Note.—The dimensions given on drawings are for tools to be used in 6-inch stand-pipes and retorts 9 feet long. The necessary changes would have to be made in other cases.—*Com*

5. Describe, with a sketch, the making of a 2-inch service connection to a 6-inch main.

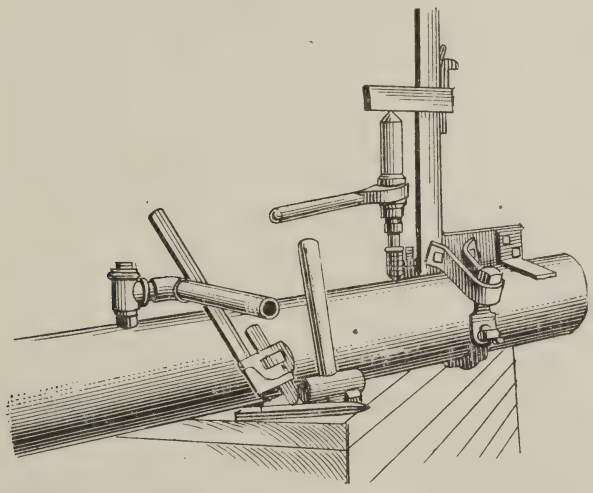
Ans. As this question deals only with making the service connection, all reference to digging the hole through different kinds of pavements, and running the service pipe, will be left out.

Assuming a hole dug down to and under the main, with sufficient room for operating the ratchet, and space under the main for the crow, we must have at hand the following tools and fittings for a 2-inch connection: tapping crow; ratchet; 1½-inch combined tap and drill; diamond point; hammer; monkey-wrench (or Stillson); bar of pliable tough soap; one 1½-inch x 1½-inch x 2-inch street tee; one 2-inch street elbow; one 2-inch plug, and one 1½-inch plug.

Select the point of tapping, and with the diamond point cut a circular groove slightly smaller than the 1½-inch tap. Cut this so deep that the iron is partly penetrated, stopping the holes, as made, with soft soap. A blow from the hammer will dislodge the central piece, and a piece of soap should at once be placed over the hole, to stop the gas from escaping. Now adjust the crow firmly in place, and set up the tap and ratchet, still leaving soap around the point of the tap and having the slots between the cutting edges full of soap. As most of the cutting has been done with the diamond point, it only remains to complete the drilling and tapping. A little lard oil or engine oil will facilitate tapping, even in cast iron.

Leave the tap in the main; remove the crow and unscrew the tap with a wrench, or by reversing the ratchet—holding the spindle in one hand.

The street tee should have a plug in top, and a street elbow screwed in the side, it, in turn, to be plugged—all threads wetted



with red and white lead or metallic paint. This combination is screwed into the tapped hole, as the tap is withdrawn.

The tee and the elbow should be made up securely, with the elbow pointing horizontally, and at right angles with the main. It is now ready for the service pipe. Soap water should be applied to the fittings to test for leaks, especially leaks through sand holes.

Two men can best adjust the crow, etc., and another man should have his eyes on these two, to render assistance in case of asphyxiation of the men in the hole, through some accident.

A 6-inch pipe should never be tapped with a hole larger than a 1½-inch pipe tap.

(See accompanying blue-print for illustration of tools and method).—*Com.*

6. Is the specific heat of a gas, or vapor, at *constant pressure;* that is, when free to expand, as gas in a gas holder; the same, or more or less, than the specific heat of the same gas or vapor at *constant volume*; that is, when confined, as steam in a boiler? Why? (See answer to Question 6, Series 3).

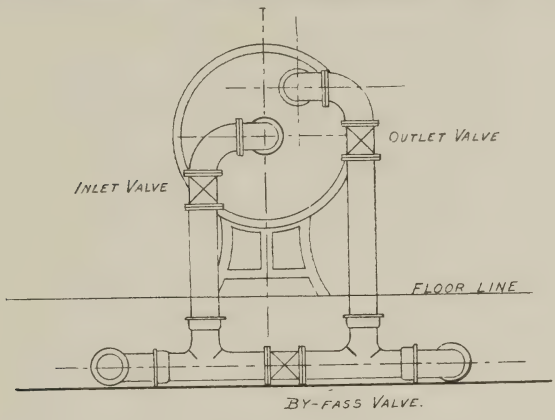
Ans. The specific heat of a gas or vapor, when free to expand, is more than the specific heat of the same gas or vapor, when confined; that is, it requires more heat to raise the temperature of a given volume of gas or vapor, from any degree to a higher degree when free to expand than to raise the same volume through the same range of temperature, the gas or vapor being confined. The reason for this will be evident, after a little thought. In raising the temperature of a confined gas or vapor, as steam in a boiler, it is only required to add the heat necessary to increase the temperature of the gas or vapor from the point at which it starts to the desired temperature. If, however, the gas or vapor is free to expand, it will expand as heated, and in expanding it must displace, or lift the atmosphere pressing upon it, an amount equivalent to the expansion. Thus, if the gas is in a holder having an area of 100 square feet, as its temperature increases the gas expands, and the holder rises say one foot. Now, the holder has done mechanical work equivalent to lifting the entire weight of the atmosphere, bearing upon the holder (about 15 pounds for each square inch of the area of the holder), through one foot in height, and the heat necessary to the accomplishment of this work must be supplied to the gas, and is in addition to the heat necessary to raise the temperature of the gas if confined.—*Com.*

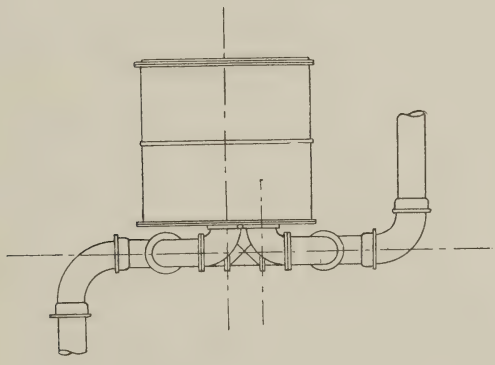
7. What is a by-pass? Give a sketch of by-pass as connected to some part of a gas work's apparatus, and describe its use and purpose.

Ans. A by-pass to any part of the apparatus of a gas works is a system of pipes and valves so arranged that by opening one or

more valves, and closing others, the gas flowing may be directed either through or past, that part of the apparatus concerned.

The accompanying sketch shows a meter by-pass. The meter may be by-passed for cleaning, repairing, or other purpose, by





"BY-PASS"
AS CONNECTED TO STATION METER.

opening the valve on the horizontal pipe and shutting the valves on the two vertical pipes.—*Com.*

8. Assume that in burning off 2240 pounds of a certain soft coal in gas retorts, 6 pounds of ammonia gas ($N H_3$) are liberated and collected in the ammoniacal liquor; that 5 per cent. is lost in

the transportation and working of the liquor; that it is made into sulphate of ammonia. How much dry sulphate of ammonia will it yield, and how much pure sulphuric acid ($H_2 S O_4$) will be used in the operation, assuming no waste of acid?

Give your calculations.

Ans. Since 5 per cent. of the ammonia is lost in transportation and working, the amount of ammonia converted into sulphate is 95 per cent. of 6 pounds, or 5.7 pounds. The formula for sulphate of ammonia is $(N H_4)_2 S O_4$ or two molecules of ammonia gas, $N H_3$, united with one molecule of sulphuric acid, $H_2 S O_4$. A molecule of ammonia gas being composed of 1 atom of nitrogen and 3 atoms of hydrogen, and the atomic weight of nitrogen being 14, and of hydrogen being 1, the atomic weight of a molecule of ammonia gas is—nitrogen, 14; hydrogen, 3; or 17. The atomic weight of 2 molecules is therefore 34. The atomic weight of hydrogen being 1, and of sulphur 32, and of oxygen 16, sulphuric acid, being a combination of 2 atoms of hydrogen, 1 atom of sulphur and 4 atoms of oxygen, has an atomic weight of 98, and the atomic weight of sulphate of ammonia will be 98 + 34, or 132. Therefore, 34 pounds of ammonia combine with 98 pounds of sulphuric acid to form 132 pounds of sulphate of ammonia, and $\frac{34}{132}$ of sulphate of ammonia, or 25.75 per cent. will be ammonia gas. Since 34 pounds of ammonia, combined with sulphuric acid, will produce 132 pounds of sulphate of ammonia, 5.7 pounds of ammonia gas will, combined with sulphuric acid, form 34 : 132 : : 5.7 : ? or, 22.13 pounds of ammonia sulphate. Of this 5.7 pounds being formed of ammonia gas, the remainder, or 16.43 pounds, is formed of sulphuric acid. The percentage of ammonia gas in pure sulphate of ammonia is 25.75 by weight. We may, therefore, prove our problem by multiplying 22.13 by .2575, which gives us 5.698,—or within .002 of a pound of the 5.7 pounds of ammonia gas, with which we started our problem. This slight difference is due to our not having carried the decimals in our divisions further than the second place.—*Com.*

9. Describe the painting of a gas holder, giving each detail of the work, and including the preparation of the iron by removal of old paint and rust.

Ans. The crown of the holder should be scraped and painted before beginning the work on the sides. Brush over thoroughly

with wire brushes, notice the seams and rivets particularly, and brush thoroughly around and between the rivets. Where the old paint is scaly, blistered, or in thick lumps, scrape the surface with chisels or scrapers. Do not let the men skip from one place to another; finish each sheet before beginning another. On the crown begin at the centre and work outward. When the cleaning is done, and when ready to paint, sweep surface with brooms and apply paint. Work it on as thin as possible, and apply two thin coats, in preference to a single thick coat. Be sure the first coat is dry before starting the second.

If leaks are found they should be stopped before the painting is begun.

The cleaning of the sides of a holder will depend upon the conditions at the works. If the holder can be put out of use, the cleaning and painting can proceed uninterruptedly. If the holder remains in use the work will proceed as opportunity offers.

In cleaning begin at top row of sheets and work down. If possible, provide a sufficient number of men to do the cleaning as the holder rises. If this is not practicable, arrange your force to cover one-half, or any other fraction of the circumference, at one time.

Provide scrapers, brooms and brushes with short and long handles. Short ladders will also be found convenient at times. There should be no hurrying, and the foreman should inspect and pass upon each sheet as it is cleaned, before the workman changes to another sheet. Faults are located more certainly this way than by inspecting at intervals.

Do not paint until the cleaning is finished for the day. Then begin at the top and work down. When the upper sheets are being painted the holder will be nearly grounded. It can be made to rise very slowly, so that by the time any course of sheets is, say, five feet above the water, the surface is thoroughly dry. The paint should be worked well in as it is applied. The paint should not run. Only such sheets as can stay above water three hours at least should be painted. When the bottom sheets are reached, have the holder up in the morning nearly to blowing, and keep it up as long as possible, so that the paint can dry thoroughly.—*Com.*

10. Name some useful purpose or purposes to which tar (coal gas or water gas) can be applied around gas works, and describe the method of preparation and application.

Ans. (A) As a paint.

(B) As a sidewalk pavement.

A. The tar must have less than 1 per cent. of water in it to be readily boiled down without use of special stills. Concentrate the tar by boiling until it will "string" between thumb and fore-finger when cooled to 60° F. When ready to use as paint, heat in quantity required for six hours' use, to about 150° F., stir in benzine in the proportion of one gallon to four of the tar. Apply hot, though as it gradually cools it can be used nearly as well, and sometimes the tar has been thinned as above while cold and used without heating, and has given satisfaction.

Naphtha is sometimes used instead of benzine. Paraffine oil is also employed as a thinner of the tar. Li ne is also considered a necessary ingredient, but if used as mentioned here, the paint will prove durable and give a hard, smooth surface.

B. For pavement for sidewalks, applied as a finishing surface 2 to 3 inches thick upon a foundation of broken stone or coarse clinkers, the top dressed with finer ashes or coke breeze, boil the tar until at 60° F. it has the consistency of vaseline. In the absence of special furnaces for the work, place a sheet of boiler plate upon stones, in the vicinity of the paving to be laid, so that it will be about one foot above the ground. On this plate throw building sand and underneath kindle a fire of wood or coke. Turn the sand over with a shovel until well heated. Gradually pour on the thick tar, meanwhile turning and mixing the mass until the sand is uniformly black and of such a consistency that a ball of it will just hold together while hot. While hot and carrying the mixture in heated iron barrows or on shovels, apply where required, leveling with a hot rake and ram with a hot rammer. Then sprinkle the surface with fine sand and roll, using preferably a heavy hand-roller. This may be made of a piece of cast iron street main, with ends plugged and centre filled with sand.—*Com.*

11. A pound of a certain coal contains 14 ounces of carbon and ½ ounce of hydrogen. What would be the products of its complete combustion, and how much would each product weigh?

How many "heat units" would be developed by the complete combustion of this carbon and hydrogen?

Give your calculations.

Ans. The product of the complete combustion of carbon is carbonic acid. Each atom of carbon has a combining or atomic weight of 12, and combines with 2 atoms of oxygen, having a combining weight of 16, to form carbonic acid—$C O_2$, which has a combining weight of $12 + (2 \times 16)$, or 44. In other words, 12 parts by weight of carbon burn to 44 parts of carbonic acid. Therefore, 1 ounce burns to $\frac{1}{12} \times 44 = 3\frac{2}{3}$ ounces $C O_2$, and 14 ounces of carbon will burn to $3\frac{2}{3} \times 14$, or $51\frac{1}{3}$ ounces of carbonic acid.

Hydrogen burns to water vapor. Two atoms of hydrogen combine with 1 atom of oxygen to form water vapor—$H_2 O$. The combining weight of hydrogen being 1 and the combining weight of oxygen 16, the weight of water vapor resulting is $(1 \times 2) + 16$, or 18. Two ounces of hydrogen, therefore, burn to 18 ounces of water vapor, and $\frac{1}{2}$ of an ounce of hydrogen will burn to $\frac{1}{4}$ of 18 ounces of water vapor, or $4\frac{1}{2}$ ounces. Therefore, the products of the combustion of coal containing 14 ounces of carbon and $\frac{1}{2}$ ounce of hydrogen will be $51\frac{1}{3}$ ounces of carbonic acid and $4\frac{1}{2}$ ounces of water vapor, if the sole combustibles in the coal, as understood by the problem, are carbon and hydrogen, and these burn in air.

One pound of carbon, in burning, develops a heating power equivalent to 14,544 heat units. Fourteen ounces, or $\frac{7}{8}$ of a pound of carbon, will develop, in burning, $\frac{7}{8}$ of 14,544, or 12,726 heat units. One pound of hydrogen, burning to water vapor, develops 61,524 heat units, and $\frac{1}{2}$ ounce, or $\frac{1}{32}$ of a pound, will therefore develop, in burning, $\frac{1}{32}$ of 61,524, or 1922 heat units. The total heating power developed by the combustion of this coal will therefore be $1922 + 12,726$, or 14,643 heat units. The actual amount of heating power developed would be somewhat less, because a certain amount of the heating power of the hydrogen and carbon would be consumed in breaking up the chemical combination in which the hydrogen and carbon exist in coal before these elements could combine with oxygen to form carbonic acid and water vapor.—*Com.*

12. What is the specific heat of H ?..... 3.4046
" " " C O ?..... .2479
" " " $C O_2$?..... .2164
" " " N ?..... .2440
" " " O ?..... .2182
" " " Steam ?..... .4750 — *Com.*

Circular of the Education Committee to Members of the Practical Class of the American Gas Light Association.

Each member of the Educational Class who has sent in answers to the last list of questions for the 1897 session, and each member who entered the Class December 1, 1897, will find enclosed a first list of questions for the 1898 session. The members who joined the Class December 1st will receive a list of questions made up from previous lists. The Committee's answers to these questions may be found in the published proceedings of the American Gas Light Association. It is hoped that each member of the Class will, for his own good, refrain from consulting these answers until he has sent in to the Committee a list of the answers obtained by him, either from conversation with his associates, or from the study of books bearing upon the several subjects. If a student simply copies the answer as published, or reads it, and writes the answer from memory, he loses a large part of the value that can come to him from the work of the Class.

A new list of questions is sent to each member who joined the Class prior to December 1, 1897, and who sent in answers to the last list of questions. Each member of the Class of 1897 who failed to answer the last list of questions will please regard this as a notice that the Committee understand that his failure to answer the questions heretofore sent him indicates that he desires to sever his connection with the Class work. There has been, in the past, a great deal of delay, and the Committee believe, often unnecessary delay, in sending in answers to questions. This delay embarrasses the work of the Committee very much, and is a decided drag on the Class. Hereafter it will not be permitted. The time in which questions may be answered will be somewhat increased, and all

members of the Class must have their answers in at the date named.

Answers to the enclosed list must be in the hands of the Committee not later than April 1, 1898.

Please write your name and address at the head of the first page of answers.

Please write your answers on one side of the paper only.

It is hoped that the members of the Class will write freely to the Chairman on any matters relative to the Class work that perplex them.

Please note that all communications, answers to questions, etc., should be addressed to WALTON CLARK, Chairman, 813 Drexel Building, Philadelphia; and the envelope containing such papers should have on it the name and address of the sender, together with the words "Educational matter."

January, 1898.

FIRST LIST OF QUESTIONS SUBMITTED TO THE SECOND EDUCATIONAL CLASS OF THE AMERICAN GAS LIGHT ASSOCIATION—1898.

1. Illuminating gas may, generally speaking, be divided into three classes, each class bearing the name of the material, or one of the materials, from which it is made. Give the name of each class, the materials from which each is made, and the useful products, other than gas, resulting from the process.
2. What danger is to be guarded against in storing bituminous coal? Is this danger greater with dry coal, or with wet coal? With fine coal, or with large coal?
3. Give one or more reasons why an exhauster is an advantage in a coal gas works.
4. Explain the construction and use of the syphon pressure gauge.
5. Why is it necessary to grade street mains?
6. How does a suction pump lift water? Explain the action of the piston, or sucker, and of the two valves of the suction pump.

7. What is meant by the expression "five degree gas liquor"?
8. What part of a coal gas apparatus is especially designed for the removal of ammonia gas?
9. Upon what property of ammonia gas do we depend for its removal from coal gas?
10. How many feet of ammonia gas will one foot of water, at 60° temperature, absorb?
11. Explain the use of the relief holder in water gas manufacture.
12. Describe the ordinary tests for the presence of carbonic acid, ammonia, sulphuretted hydrogen.
13. Explain what is meant by the expression "chimney draft."
14. What is the action of the water seal, as applied in the hydraulic main of a coal gas works, and the wash-box of a water gas works?

Answers must be in Committee's hands April 1st.

First Series of Questions for the Educational Class of the American Gas Light Association—1898.

1. What are the characteristics of good Portland cement?
2. Describe the proper method of preparing and putting in a cement and broken stone concrete for foundations in dry, or nearly dry earth.
3. What is "English bond" in brick work? Show by sketch and description.
4. Make a sketch showing the vertical cross-section of a brick foundation five bricks wide at bottom, three bricks wide at top and six courses high, "breaking all joints."
5. Describe briefly and generally a system of charging retorts by machinery.
6. Describe the testing of a consumer's meter. Give all precautions observed.
7. Describe the preparation for, and the conduct of, a general examination of a distributing system, with the object of reducing leakage.
8. Describe some form of apparatus for separating water gas tar from its accompanying water, the purpose being to remove all appearance of tar from the work's drainage.

9. Describe, with sketch, the stopping of a ragged hole, about one-quarter inch in diameter, in a holder sheet too thin to permit tapping a thread.

Answers must be in Committee's Hands April 1st.

Circular of the Education Committee to Members of the Practical Class of the American Gas Light Association.

Enclosed herewith are the Committee's answers to the first list of questions for 1898. No other questions will be sent out for the present.

Instead of criticising the members of the class for delay in sending in their answers, the Committee on this occasion has to apologize for its delay. The Chairman has been obliged to give up the work, and the Secretary, who attempted to take it up, finds it beyond his power to carry it on. He has not made up another list of questions, as for the next few months he will be occupied with the preparations for the meeting of the Association and the publishing of its Annual Volume of Proceedings, and he could not handle the answers if sent in.

An attempt is being made to complete arrangements by which the work of the class can be resumed December 1st, and carried on as before. Until these arrangements are completed the Practical Class, much to the regret of the Committee, must enjoy a vacation.

Please address all communications to Alfred E. Forstall, Secretary, Montclair, N. J., instead of to Walton Clark, Chairman, as heretofore.

Answers to the First List of Questions Submitted to the Second Educational Class of the American Gas Light Association—1898.

1. "Generally speaking, illuminating gas may be divided into the following three classes: Coal gas comes first, with by-products of coke, tar and ammonia (gas liquor). It is made by the dry distillation of bituminous coal.

"Water gas comes next, with tar as a by-product. It is made by decomposing steam by contact with incandescent coal or coke and enriching it with oil, or more properly speaking, with oil gas.

"Then comes oil gas. This is made by the distillation of oil, and has tar as a by-product."

2. "Spontaneous ignition is a danger that should be guarded against in storing bituminous coals. This danger is greater in wet coal than in dry, with fine coal than with large coal."

3. "As the pressure in the retort can be reduced by the use of an exhauster, the amount of deposit of carbon in a solid state on the interior of the retort is lessened to a great extent, as the amount of deposit depends on the temperature and pressure to which the gas is exposed.

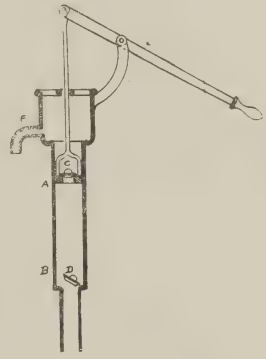
"The loss due to leakage is very much reduced, as a heavy back pressure would increase the loss.

"The amount of gas obtained is greater with the use of an exhauster than without it."

4. "The syphon pressure-gauge consists of a U-shaped glass tube, or of two vertical glass tubes cemented into a connecting tube at the bottom and containing water to a point about midway of their height. When the water in each of the vertical tubes is exposed to atmospheric pressure the height of the water in each tube will be the same. In gas manufacture the syphon-gauge is used to determine the difference between the pressure of the atmosphere and the pressure of the gas in any part of the apparatus or connecting pipes to which it may be attached. Connection is made between the apparatus or pipe, and the top of one of the vertical tubes of the gauge. If the pressure in the apparatus is greater than that of the atmosphere, the water in the tube connected with the apparatus will be depressed—the water in the other rising until the difference in the heights represents the difference between the pressure in the apparatus and the pressure of the atmosphere. If the pressure in the apparatus is less than that of the atmosphere, the water will rise in the tube connected as above to the apparatus, being depressed in the tube open to the atmosphere, until the difference in the heights of the two columns of water represents the difference between the pressure in the apparatus and the pressure of the atmosphere. This difference is commonly expressed in inches and tenths of an inch."

5. "In the laying of street mains it is of the utmost importance to see that all pipes are on a slight incline or gradient, so as to drain all condensation to a given point which is situated at the lowest part of the main, where all the condensation is collected by means of drip wells. If the pipes were not laid on a perfect gradient, there would be a collection of water in the various parts of the pipes where sags or traps occurred, which would hinder and stop the flow of gas, according to the depth of the trap, and the amount of water therein."

6. "a. By removing the air in the cylinder of the pump and the forcing of the water by atmospheric pressure on the surface of the water of the well into the vacuum so formed.



"This figure gives a sectional view of a pump, A–B being the pump-barrel. In the barrel is an air-tight piston C, moved by a lever or pump-handle; at the lower end of the barrel is a valve D, opening upward; this valve separates the barrel and completely covers the feeding pipe. In the piston C there is also a valve opening upward. Now suppose the piston C to be at the bottom of the barrel and then raised by action of the pump-handle; the piston being air-tight the pressure of the air being on the ascending valve C keeps it closed, so that the air having no escape is forced up and pumped out. The vacuum thus formed in the barrel is filled up by water, caused by the removal of the air and by the pressure of the atmosphere on the surface of the well. On lowering the piston, valve C opens by resistance of the water confined in the barrel, and the downward pressure at the same time closes valve D and prevents the water from being forced back into the well. Then on again raising the piston, the resistance of the water closes the valve C, and the water is forced out of the spout F, while another vacuum is forming below the piston and fresh water rising in the barrel."

7. "The expression 'five-degree gas liquor' is used to describe gas liquor that will show five degrees when tested with the Twaddel hydrometer. Each degree of the Twaddel hydrometer

indicates a specific gravity above the water of .005, water being taken as 1.000. Therefore the specific gravity of five degree liquor would be 1.025. For each degree Twaddel strength each English gallon of gas liquor will saturate two ounces of standard sulphuric acid of a specific gravity of 1.845. Therefore an English gallon of five degree gas liquor will saturate or neutralize ten ounces of sulphuric acid of 1.845 specific gravity. The English gallon of pure water weighs ten pounds and a gallon of five degree Twaddel liquor, will therefore weigh 10.25 pounds avoirdupois."

8. "Washer and washer scrubber."

9. "Upon its affinity for water."

10. "783.—Newbigging."

11. "Water gas, as made by the Lowe, or cupola process, is not generated continuously. It is important that the gas should be purified and measured in a continuous flow. The relief holder receives the gas as made from the apparatus, and thus acts as a governor, permitting a continuous flow through the purifying and measuring apparatus, in spite of the intermittent process of generating. It also acts as an equalizer of the gas, which will vary slightly from one period of the run to another."

12. "For carbonic acid allow the gas to bubble through lime water and if it is present the water will become cloudy.

"For sulphuretted hydrogen allow a jet of gas to play on a piece of paper which has been wet with a solution of acetate of lead; if present, the paper will turn brown, the shade of brown depending on the amount present and the time exposed.

"Yellow turmeric paper changing to brown, when held in a jet of gas, shows the presence of ammonia."

13. "'Chimney-draft' is the force of the flow of the warm gases or air through a chimney and is equal to the difference in weight of the heated gases in the chimney and the weight of an equal column of the surrounding atmosphere."

14. "The purpose of the water seal, as applied in the hydraulic main of a coal gas works, and the wash-box of a water gas works, is to permit the free passage of the gas from the generating apparatus and to prevent its return. This 'check valve' action is due to the difference of area of water in the wash-box and in the dip. If the dip-pipe is one foot internal diameter and the wash-box is five feet diameter, the area of water in the wash-box is

approximately twenty-five times the area of the water in the dip-pipe.

"If the dip-pipe dips two inches in the water of this wash-box, a pressure of only a trifle over two inches is necessary to force gas through it into the wash-box. But, before any gas can pass back from the wash-box into the dip-pipe, all the water in the wash-box above the bottom edge of the dip-pipe must be forced up into the dip-pipe. As the area of the wash-box is twenty-five times the area of the dip-pipe, the water in the box will fill the dip-pipe (25x2) 50 inches high before gas can pass. The above figures approximate those obtaining in actual practice.

"The coal gas hydraulic main operates on the same principle."

Answers to the First Series of Questions for the Educational Class of the American Gas Light Association—1898.

1. Good Portland cement is usually gray or greenish gray in color and weighs from 85 to 95 pounds per cubic foot. It should be fine-ground, and 85 per cent. should readily pass a sieve having 10,000 meshes to the square inch. It should, during the process of setting, show neither expansion nor contraction. For ordinary masonry work it should be slow in setting. For special work, done between tides or to be soon submerged, it should be quick setting. It should come in paper sacks or strong substantial barrels lined with paper or other material to protect it from dampness.

Briquettes of Portland cement one inch square in cross section should develop the following ultimate tensile strength:

AGE.	STRENGTH.
24 Hours (in water after "hard" set)	175 pounds.
7 Days (1 day in air, 6 days in water)	500 "
28 Days (1 day in air, 27 days in water)	600 "
7 Days (1 day in air, 6 days in water), 1 part of cement to 3 parts of standard quartz sand, by weight	170 "
28 Days (1 day in air, 27 days in water), 1 part of cement to 3 parts of standard quartz sand, by weight	240 "

2. A good bed of plank about 10 ft x 16 ft. should be laid, on which to mix the concrete. The stone used should be clean, and

the sand should be clean, sharp and coarse. The proportions depend upon the strength required, but a good concrete is composed of:

1 barrel of Portland Cement.
2 barrels of Sand.
5 barrels of Broken Stone.

Broken slag or coarse gravel may be substituted for the broken stone, but in all cases it should be entirely free from loam.

The materials should always be measured. Two boxes about 12 to 14 inches deep, one of two and one of five barrels capacity, having no bottom, are convenient measures. Mix the cement and sand dry, with a hoe or shovel, level the stone and wet it down thoroughly, then spread the dry mixture of sand and cement evenly over the stone and mix thoroughly by turning over twice. The additional water necessary should be added during the second turning.

The finished concrete should be loaded in barrows, quietly dumped and then rammed until the moisture appears on the surface. In no case should it be thrown into place with shovels or dropped from any height, for the stone becomes separated from the mortar. The concrete should be laid in layers of not less than 5 in. or more than 9 in., and when joined to old work, the old work should be carefully cleaned, wetted-down, and dusted with dry cement.

In preparing the excavation, the earth should not be disturbed, and should it be loosened or disturbed, it must be rammed until firm. Where soft or yielding earth or sand occurs, the bottom should be planked and the concrete laid on this planking.—*Com.*

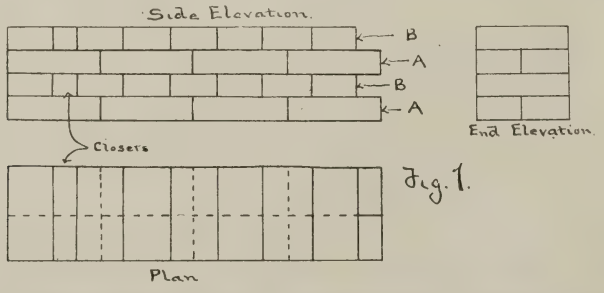


Fig. 1.

3. English Bond consists in laying entire courses of headers and stretchers periodically, as shown in Figure 1, where courses

marked A are of stretchers, and those marked B of headers, and is considered the strongest and most stable arrangement of brick in masonry work. Sometimes the courses of headers and stretchers occur alternately; ordinarily there is only one course of headers for every four, five or six courses of stretchers. The stretchers tie the wall together lengthwise, the headers crosswise. The proportionate numbers of the courses of headers and stretchers should depend on the relative importance of transverse and longitudinal tenacity. One course of headers to two of stretchers gives equal tenacity to the wall lengthwise and crosswise, and may be considered the strongest in ordinary cases.—*Rankine.*

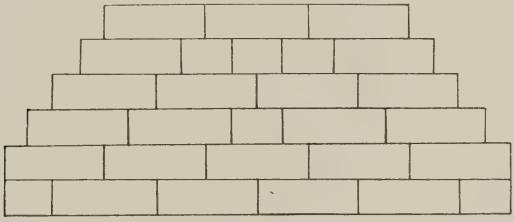


Fig. 2.

4. See Figure 2.

5. The Ross Discharging Machine.

The discharging machine carriage is made up of I-beams mounted on wheels, and is driven with a small engine on rails laid upon the retort floor in front of and parallel to the benches.

On one side of the carriage are mounted an upright boiler, a water tank, feed pump, propelling engine, a horizontal engine, and a water cataract or governor.

Located transversely across the other side is a rectangular upright frame, the horizontal braces of which are the guides for the reciprocating traveler.

The rake bars can be raised or lowered at will and are guided by grooved rollers and flat-faced wheels turning on studs to sustain and guide the rake bars, any one of which can be clamped to the traveler or to the rear columns when not in use.

The traveler is a hollow cast iron cross head riding between the guides upon duplicate grooved friction rollers above and below. The successful operation of the machine is due to the ingenious

manner in which motion is given to the traveler. The steam cylinder is placed opposite to the water cylinder, both having a common piston-rod, and each having a piston attached to the rod, somewhat similar to a steam pump. The two ends of the water cylinder are connected by a pipe with a valve in the centre, so that the flow of the water can be nicely adjusted. The water in the cylinder forms a cushion alternately at each end, thus preventing any shock or jar to the machine. On the piston-rod between the steam and water cylinders is a rack, working a pinion which works a chain wheel on the same shaft, and this chain being attached to the traveler, operates the same, sending it backwards and forwards and carrying the rake to which it is attached with it. The possibility of any shock from the traveler against the end columns of the frame is avoided by rubber buffers, but the working of the machine is so easily controlled that it is seldom that they ever come in contact. The rake beams are of rolled angle iron, and the rake heads are steel castings suited to the shape of the retorts, and hinged to the ends of the rake beams.

The whole of the movements of the machine are governed by levers operated by one man, who is stationed at the extreme rear end out of the way of smoke or steam, and commanding a clear view of the interior of the retorts.

The charging machine consists of a rectangular carriage mounted on axles, to which are keyed the flange track-wheels. On one side of the platform are located the vertical boiler, steam reservoir, water tank, feed pump and disc engine for propelling. Upon the opposite side are located the charging hoppers mounted in a vertical frame securely braced and supported upon axles, to which are keyed the wheels running upon rails laid across the platform of main carriage. Between these hoppers and the boiler is a steam cylinder for moving the hoppers back and forth, the motion being accomplished by a reciprocating movement imparted by a rack attachment to piston gearing, and a pinion to the shaft of which is secured a drum over which a wire rope coils in reverse directions. By the movement of a lever the hoppers are moved forward to the front of benches for the purpose of charging, or backward to the end of traverse rails for the purpose of refilling with coal from the storage bin. At the bottom of each hopper ten $\frac{3}{8}$-in. horizontal nozzles are connected, through which the steam is discharged in successive blasts against the coal, projecting it into the retort.

The blast pipes are connected with a vertical 3-in. steam stand-pipe which is in turn connected to main steam pipe by a swivel-jointed connection, and a full way quick-opening valve, the handle of which is located within easy reach of the operator.

The steam reservoir serves as an accumulator to maintain the volume of steam necessary to give a uniform pressure during the operation of charging, and to relieve the boiler from any sudden strain or shock due to the quick opening of the valve. In the practical operation of charging, the machine is moved opposite the retorts previously discharged, the hoppers filled from the storage bin, moved forward until the conduits enter the mouth-pieces of the retorts and stopped automatically at the proper point. The operator then projects the coal into the retort by quickly opening and closing the full-way valve three or four times. By the exercise of ordinary intelligence in graduating the duration and force of each blast, he can distribute the charge with as great, if not greater uniformity, than is ordinarily accomplished with scoop or shovel—the actual time occupied in charging three retorts seldom exceeding five seconds.

(For description of "Bronder" machine, see American Gas Light Journal, Vol. LXVII—26—1004.)

(For "Arrol-Foulis," see Hornby, page 48, and Journal of Gas Lighting, Vol. LXVIII—1736—314.)—*Com.*

6. "Consumers' meters should be allowed to remain in the same room with the meter-prover at least one hour before testing, to allow the meter to become of the same temperature as the air and water in the meter-prover. Meters should undergo three distinct tests:

First.—Test for registration on a small flame, about the size of a small copper cent; this is to detect any leakage in the valves, or any holes in the diaphragm. If no registration appears when this test is made, the meter should go to the shop for examination.

Second.—Test for irregularity of delivery, to show any stiffness or derangement of the internal mechanism of the meter. To give the test the greatest precision, the meter should be connected to a cluster or line of lights, of or near its full capacity, and if there is any irregularity in the working of the meter, it will show in fluctuation of the flames, and the meter should go to the shop.

Third.—If both of the above tests show that the meter is in good working order, the third test should be for accuracy of registration.

When the meter has been connected to the prover, one or more cubic feet of air should be allowed to pass through the meter, to expel the gas remaining after the first two tests, then bring the hand on the prover to an even mark as to cubic feet of air in prover, and the test hand on the meter to zero, and open the air passage between the prover and meter and allow the air under the prover-cylinder to pass through the meter, and when the test hand arrives at zero again, the scale on the prover shows to what extent the meter was in error. If meter shows fast 1 per cent. or 1½ per cent. slow, it is considered correct, but beyond these limits it should go to the shop for adjustment or other repair, as examination may dictate.

All meters when not in use should be kept tightly corked, and no meter should be set which has not been tested within 30 days.

7. The first step is to carefully test the station meter and see whether the gas made is correctly measured. Then if a regular system of testing consumers' meters is in vogue, the average reading of these may be considered correct, and the gas unaccounted for will be the true leakage.

In the first place look over the street lamps. If they are supposed to be burning 3 or 4 feet per hour, see that they are not burning 8 to 10 feet. This remedied, a general examination of the mains is in order. It will be found advisable to divide the system into say half a dozen convenient districts, and begin work on the one that probably has the largest leakage, due to old mains or service, filled-in ground, or poor work in original laying. These districts should be subdivided into sections, with a view of isolating them from the remainder of the system, and passing gas into each section thus isolated through a meter, the consumers' meters in such section having been all shut off. The registration of the meter will naturally be the leakage for that section. If this test should show a leakage of 50,000 c. f. or more per mile of 3 in. main per year, then barring must be resorted to to locate the leaks.

For a section where it would be practically impossible to cut off the consumers for testing, and the leakage is known to be great, barring should be resorted to without test, and will pay for itself.

In selecting sections to be tested, have in view the greatest amount of main with the fewest points of supply, so as not to en-

tail sealing the main at too many places. Locate the meter generally at the largest supply main, at a valve if there is one conveniently located.

There are several ways of sealing the main: first, with valves already in place, be sure these are tight; if not so, dig up, tap a ⅜-in. hole in the side; if a double gate, insert a street-ell and 2 ft. riser, then wash the valve out by flushing with water. If not tight then, close valve and hold 2 ft. head of water on inside while testing. Another plan is to tap a slightly larger hole than usual for bagging—put two bags in this hole, one to right and one to left—fill the space between the bags with water, putting a 3 in. nipple in hole and keeping water level with its top. Should the water run past the bags very quickly, wash the main with a bunch of waste and stick and try again, pouring in some cylinder oil or mixing some oatmeal with the water. Another form of seal is to tap a very large hole, put in two balls of wet yarn, one on each side, and cement the main with a mixture of fire-clay and cement, half and half, putting a sleeve around the main at this point when testing is completed.

Now for shutting off meters. It will take from one to two hours to shut off the meters, three men being able to shut about 100 in this time. Notify every consumer before shutting, and when turning on. It is preferable to use the meter cocks to the street stop cocks, as you then include the services in the test. When the main is sealed and consumers shut off, set a meter on a by-pass around one of the seals, having a pressure gauge on inlet and outlet. Note the amount passed for 15 minutes or one-half hour, checking every five minutes. Calculate amount per year per mile 3-in. main. If this is excessive it must be repaired.

Barring for leaks.—Barring or sounding is the driving of a pointed steel bar down to the main over the joint, so that leaks at these points will be discovered by smelling the gas coming up out of the hole, unless the ground is wet and marshy. Barring to be profitable must be systematic and when employed in connection with testing districts by meter, will be found most satisfactory. A barring gang should consist of at least ten men (foreman, 4 to 6 sounders, 1 caulker and rest laborers, using two of the sounders for extra digging if necessary), and for large systems augment accordingly.

In the first place locate the main and joints; if the records are accurate and carefully kept, this will be an easy matter; if not, dig up the intersection at cross seats at which leaks will often be found. Draw a line between two adjacent ones, measure off from the exposed joint every 12 feet (if the pipes are that length) a rope with red tape tied every 12 ft., making a convenient measure. Drive the bars at the points thus marked. Use a hexagonal or round bar of tool steel about 5 ft. 6 in. long and 1⅛-in. diameter (1 in. diameter if ground is soft), tapered for about 12 in. to a point. Use a 6-lb. hammer or heavier according to soil. If very hard, proceed by a short 2 ft. 6-in. bar to get through the crust. Having located the main, start three bars going, two men to each bar except where the ground is very soft, when one man will do. Drive the bar until it strikes the main, which can easily be told by the sound and solidity. Draw the bar up, being careful to keep the hole clean. Magnetic particles of iron will be found on the point of the bar if the main was struck fair; if a glancing blow was struck a black streak will be found on the side of the point. It is not absolutely necessary to strike the main every time, but to be sure that you are not far away, hit it at least in every third hole.

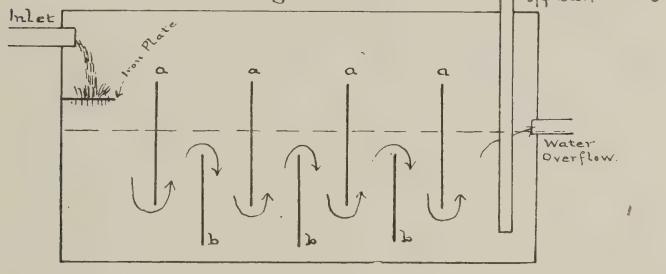
The sounders should then smell the hole, leaving it open and going to the next joint. The foreman should then smell, leaving it open for about ten minutes, and smelling again before closing. If a strong leak is apparent it will be evident all the time; stale gas will not last and may be detected by the "sourness" of the smell. Should three or four adjacent holes smell, allow to remain open and the strongest will soon predominate. Dig up the main at this point. When the bell is exposed, check the position of the other bells by new measurements and see that the holes were not far out; if over two feet drive new holes over the joints. The bars may be removed by striking each side alternately and lifting, or a monkey-wrench may be used to turn and loosen. A yoke is sometimes used by laying on the ground and driving bar through it, then lifting yoke, this will catch the upset head of the bar. Should a lead joint be leaking, re-caulk; if it drives back ¾-in or more, either put in a new ring or repour; never point up with cement. Should a cement joint leak, dig out with the first string of yarn and put in new yarn and make over with cement, using preferably tarred yarn and Portland cement.

Should the main be broken, clean the pipe thoroughly, wrap with band of canvas covered with white lead, wrap yarn around, put on a split sleeve set in cement. If the main should be punctured by a bar, dig up, tap with most suitable size and plug.

A sketch and record on cards or in a book should be made of the main wherever exposed, telling the size, depth, etc., and all distances from curb or property line, for future use. A small mirror will be found indispensable for examining the main on under side. Never use a light or fire a ditch; test all joints with soap-suds and a brush.

If possible to close the holes, never leave them open at night. When filling, tamp the earth solid, especially around the main. Repave always, if not permanently, temporarily, as it will leave the street in better condition, and the cost is slight.—*Com.*

Fig. 3.



aa. Skimmers. bb. Partitions.

8. "An effective apparatus for separating water gas tar from its accompanying water, is shown in Fig. 3. and consists of an oblong rectangular box of wood or iron, say 4 ft. wide, 5 ft. deep, and 16 ft. long, buried in the ground to such a depth as to receive all wash-box and drip water, and to empty into a sewer or other drain. This box is provided with a series of cross partitions at intervals of 18 in. or 2 ft., every other partition reaching from within say 5 in. of the bottom of the box, to within 4 to 6 ins. of top surface of liquid in box. Alternating with these partitions are others which reach from within 2 ft. of bottom of box, up above surface of liquid, and are called skimmers. The liquids to be separated are admitted at one end into the box (if possible from a height of several feet), falling on an iron plate and thence flowing through separator. This striking of tarry liquids on iron plate helps to break up the

vesicles of tar and water. Another way would be to urge the stream of tarry water against a plate, by aid of a steam jet. The liquid flows, the slower the better, over and under the partitions, each reversal of current helping to precipitate the tar at the bottom; any light oils come to the top surface, and are held by the skimmers until removed.

"The wider and deeper the box, the slower the motion of a given quantity of fluid per hour; the longer the box the more complete the separation. The higher the bottom of skimmers from bottom of box, the greater the capacity of the box to hold the separated tar between periodical drawings off. The bottoms of the other partitions are only above bottom of box, to enable accumulated tar to be drawn off from one end; the tar will never be completely drawn off, so that there is no danger of liquid flowing direct from one end of box to other under partitions.

"Bottoms of skimmers should not be too high above bottom of box, however, for total depth of box, or the zigzag reversals of currrent would be too slight. Keep box covered with hatches, and if necessary warm with steam pipes in winter to keep temperature about 150 degrees Fahr."

9. "Make the hole oblong, say 1 in. to 1⅛-in. long, by $\frac{5}{16}$-in. wide. Flatten the head of a ¼-in. bolt until it is only ¼-in. wide. Make a cast iron or other washer, 2 in. in diameter, with the hole a tight fit over the bolt. Mix a stiff paste of glycerine and litharge, red lead or any similar substance. Tie a string to the bolt, put the flattened head through the hole, give it a quarter turn, slip the washer coated with the paste over the bolt, grummet this with lamp wick, screw down the nut until everything

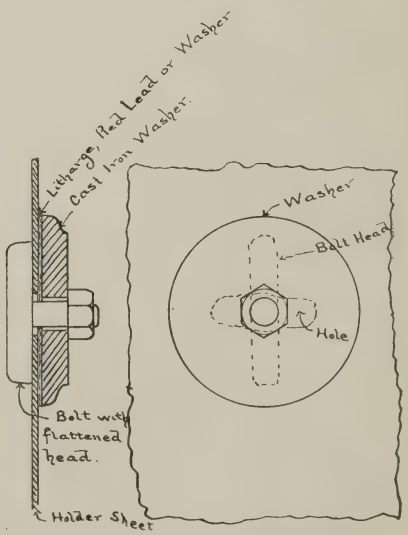


Fig. 4

is drawn up tight, saw off the projecting end of the bolt and the job is complete."

[This Appendix to the Committee's Report was not read at the meeting.]

THE PRESIDENT:—If there is no objection, the report will be received and placed on file. I think that Mr. Humphreys has a word to say with regard to this report.

MR. A. C. HUMPHREYS:—I would like to say a word or two about the Educational Fund. You have heard the gist of our report in the recommendations made by the Council. The Council thought it was not worth while to burden you with a mass of details, as we wanted to get down to the real business of the meeting—the reading of papers, as soon as possible. I may be able to give you a little more information than perhaps you have at present with regard to the work which has been done by your Committee. We started out to raise not less than $3,000. We knew that with less than that the plan could not be carried through successfully. We have to date raised $3,193 per annum for the next five years. I would like to explain this for the benefit of some who have subscribed a lump-sum. We found that quite a number were willing to subscribe a lump-sum who were not willing to pledge themselves for an annual payment for five years. To make it easy for them we said that we would be glad to take their money now, and we would distribute the amount through the five years. Where such single lump-sum subscriptions have been made, we have only placed one-fifth of these sums in the column of annual subscriptions. We wish to have this point clearly understood. We feel that if this idea could be scattered broadcast throughout the Association, this fund might yet be very largely increased. We feel very sure that there are many members who would be glad to identify themselves more actively with this scheme. We will be glad to receive subscriptions of from five to ten dollars, even without pledge as to the future. It will be very pleasant and encouraging to those engaged in this work to feel that the membership of this Association is generally lending its support. I hope this idea will take root in your minds, and that you will help to scatter it among the members of the Association whom you may meet. You may think that, having raised $3,193, we should rest satisfied; but you can

readily see that under the active management of a salaried representative, who is going to devote his time almost exclusively to the work, the work itself is likely to grow and our expenses will be likely to increase. Furthermore, we have to look forward to the end of the five years. We had to establish a time-limit in going to people for subscriptions in the first place, but personally, we have no question at all as to the ultimate success of the endeavor; therefore we wanted to look ahead and get a right start for the next term of five or ten years, whatever it may be. If we can establish an endowment, you can all see what a great assistance it would be to us. We may be able to place the lump-sum subscriptions in a special fund and use only the interest; in other words, to commence a modest endowment. I find in talking with some members of the Association, that they are still disposed to question whether such a plan of education can be successfully carried out. In reply to that I simply wish to say that there is no question about it; it has been demonstrated, and demonstrated in advance of asking for your financial assistance,except to a very limited extent. We have merely come to you so far each year and asked for a small amount to meet the actual disbursements for printing, postage, and the like. The work has been done gratuitously. We know from discussing the matter with those who have taken advantage of the work, that we are doing good—that we are helping men to properly equip themselves for positions of trust in our business; and in doing that we think we have no need to apologize in asking for your further assistance.

MR. HARBISON:—On this subject of Educational work for the Association, I desire to say a word to the Association and to make a personal explanation of my position in this matter. I have received, as other members have, a circular from the Committee, asking for subscriptions. The Company which I represent has not responded to that request. For several years this matter has been discussed among members of the Association and it has been well understood that no educational institution in this country has taken up the subject of Gas Engineering as a part of the studies to be pursued in that institution, in any college or institution of learning. In Hartford we have, as you all well know, Trinity College, where young men from different parts of the country receive an education. We have repeatedly urged on the Faculty of Trinity College that they should make the study of Gas Engineer-

ing a part of their educational work. When we received this circular from the Association that matter was already under special consideration by the Faculty of Trinity College. The Hartford Gas Company had offered to the Faculty of Trinity College the free use of their Gas Works for such work as they might want the young men who should take up this study to make use of. And they offered them the free use of such quantities of gas as they might want for experimental purposes. They offered them facilities for work in the Street Department, without cost to the Institution. I am pleased to be able to say that a number of young men who come from the cities and towns in which members of this Association have an interest, and seek their education at Trinity College, will next fall, have the benefit of the special course in Gas Engineering. We hope to do at least our share in this educational work, in training the young who desire to take up the study of Gas Engineering in connection with Trinity College, and hence we have not responded to this request of the Committee or subscriptions to the fund, thinking that we have in this direct way done perhaps what it was our share to do.

Mr. Beal:—I move that the thanks of the Association be given to Mr. Walton Clark for his able, thorough and self-sacrificing efforts in advancing this work; I ask a hearty and unanimous vote.

The President:—You have heard the motion of Mr. Beal, and I know you will express your hearty accord by giving him a rising vote.

The next report is that of the Committee on Research, of which Mr. Alten S. Miller is Chairman.

Mr. Miller read the following report:

Report of the Committee on Research.

To the American Gas Light Association:

Gentlemen:—Your Committee would like to thank the members who have so kindly prepared papers on some of the subjects suggested at the last meeting, and hope that the members will discuss the subjects freely and fully. Much good can be accomplished by going thoroughly into a subject when it has once been opened, and we hope that the members will not feel that it

has been exhausted until all the facts bearing on it have been placed on record.

Of the subjects suggested last year, we are promised papers bearing on the following:

"The Self-Enrichment of Coal Gas."

"The Effect of the Depth of Fire on the Practical Efficiency of a Water Gas Generator."

"The Loss of Illuminating Power of Twenty-five to Thirty Candle Gas when Mixed with Air."

This leaves untouched the following subjects:

"The Measurement of High Temperatures"

"The Production and Separation of Cyanides."

"The Removal of Tar from Water Gas."

"The Effect of Regenerative Benches and Anti-dips on the Production of Ammonia."

Another subject for investigation has been suggested by our Secretary which is,

"At What Point Should the Coal and Water Gas be Mixed in a Combination Works to Insure the Best Results."

We hope that there are enough members of the Association who have its interests at heart sufficiently to present papers on these subjects at the next meeting. Meanwhile other subjects for research should be suggested, and your Committee will be under obligations to any one who will suggest such subjects.

A table for house-piping has been prepared according to the instructions given at the last meeting. This table is based on a loss of pressure of one inch of water in five hundred feet. The table has been published and distributed among the members.

TABLE FOR HOUSE PIPING.

PROPOSED BY RESEARCH COMMITTEE.

$$Q = 1350 \sqrt{\frac{d^5 p}{1/3\ l\ g}}$$

Loss of pressure assumed $\frac{1}{10}$-inch of water for 50 feet of pipe.

d = diameter in inches.

p = pressure in inches of water.

l = length of pipe in feet.

g = specific gravity of gas compared with air.

Q= cubic feet of gas per hour.

"g" assumed to be .680.

"d" and "l" assumed. "Q" calculated.

d	l	Q	d	l	Q
⅜	20	11	1½	150	349
½	30	22	2	200	718
¾	50	60	2½	300	1253
1	70	127	3	450	1977
1¼	100	222	4	600	4059

"Q" is the maximum duty per hour for pipe of the length and diameter given.

No greater length of pipe should be used than is given in the table e. g.; the maximum length of 1-inch pipe allowable under any circumstances is 70 feet and it should not be expected to carry over 127 cubic feet of gas per hour.

We recommend the adoption of the "Standard Gas Works Castings of the Society of Gas Lighting. These standards have recently been modified by the Society as follows:

1. The diameter of the bolt circle on the 30″ flange has been changed from 34½″ to 35″.

2. The lead groove in the hub has been turned around so that the deepest indentation is towards the face of the hub instead of the bottom as before. The distance from the face of the hub to the groove is ½″ and the groove is ¾″ long as before.

3. The following weights for pipe are suggested for ordinary work:

SIZE.	Weight per 12 ft. length.
4	220
6	350
8	490
10	570
12	860
16	1326
20	1900
24	2400
30	3400

Respectfully submitted,

ALTEN S. MILLER,
CHAS. F. PRICHARD.

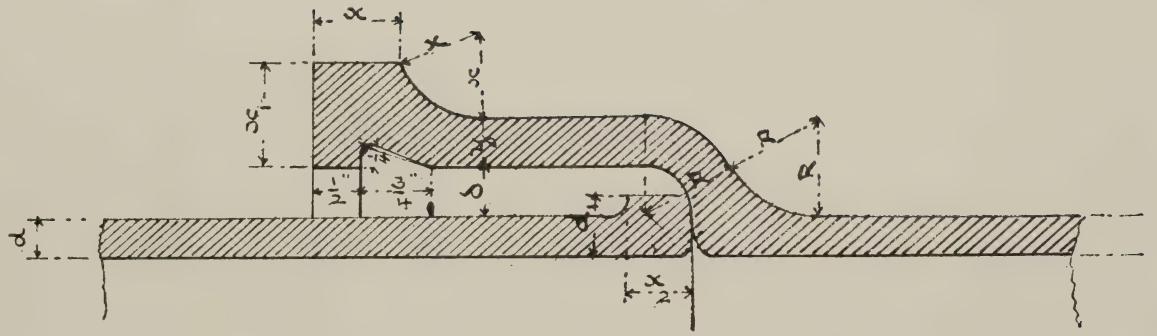
MR. MILLER:—I should say that Mr. Thompson has been unable, on account of his health, to sign this report. He has however done a great deal of work in this connection, and has been able to persuade some of the members to write papers for us.

On motion of Mr. Nettleton the report was accepted, the recommendations adopted, and the Committee continued.

APPENDIX TO REPORT OF COMMITTEE ON RESEARCH.

STANDARDS RECOMMENDED AND ADOPTED.

This Appendix to Committee's Report was not read at Meeting.



$x = 2.33\,d \quad x_1 = 3.00\,d \quad x_2 = 1.80\,d \quad y = 1.40\,d \quad d_1 = d + \frac{1}{4}\text{ INCH}$

$R = y + \delta$

Fig. 1.

Table of Dimensions of Bells and Spigot Ends. (See Fig. 1.)

Diameter of Pipe.	Thickness of Pipe.	Diameter of Bell.	Depth of Bell.	Lead Joint. δ	y.	x.	x_1	x_2	d_1	R.	m.	n.
30 in.	$\frac{7}{8}$ in.	$32\frac{3}{4}$ in.	$4\frac{3}{4}$ in.	$\frac{1}{2}$ in.	$1\frac{1}{4}$ in.	$2\frac{1}{16}$ in.	$2\frac{5}{8}$ in.	$1\frac{5}{8}$ in.	$1\frac{1}{8}$ in.	$1\frac{3}{4}$ in.	$\frac{3}{4}$ in.	$\frac{3}{16}$ in.
24 "	$\frac{3}{4}$ "	$26\frac{1}{2}$ "	$4\frac{3}{4}$ "	"	$1\frac{1}{16}$ "	$1\frac{3}{4}$ "	$2\frac{1}{4}$ "	$1\frac{3}{8}$ "	1 "	$1\frac{9}{16}$ "	"	"
20 "	$\frac{3}{4}$ "	$22\frac{1}{2}$ "	$4\frac{1}{2}$ "	"	$1\frac{1}{16}$ "	$1\frac{3}{4}$ "	$2\frac{1}{4}$ "	$1\frac{1}{4}$ "	1 "	$1\frac{9}{16}$ "	"	"
16 "	$\frac{5}{8}$ "	$18\frac{1}{4}$ "	4 "	"	$\frac{7}{8}$ "	$1\frac{1}{2}$ "	$1\frac{7}{8}$ "	$1\frac{1}{3}$ "	$\frac{7}{8}$ "	$1\frac{3}{8}$ "	"	"
12 "	$\frac{9}{16}$ "	$14\frac{1}{8}$ "	4 "	"	$\frac{13}{16}$ "	$1\frac{5}{16}$ "	$1\frac{11}{16}$ "	1 "	$\frac{13}{16}$ "	$1\frac{5}{16}$ "	"	"
10 "	$\frac{1}{2}$ "	12 "	4 "	"	$\frac{11}{16}$ "	$1\frac{3}{16}$ "	$1\frac{1}{2}$ "	$\frac{7}{8}$ "	$\frac{3}{4}$ "	$1\frac{3}{16}$ "	"	"
8 "	$\frac{7}{16}$ "	$9\frac{7}{8}$ "	4 "	"	$\frac{5}{8}$ "	$1\frac{1}{16}$ "	$1\frac{5}{16}$ "	$\frac{3}{4}$ "	$\frac{11}{16}$ "	$1\frac{1}{8}$ "	"	"
6 "	$\frac{3}{8}$ "	$7\frac{3}{4}$ "	4 "	"	$\frac{9}{16}$ "	$\frac{7}{8}$ "	$1\frac{1}{8}$ "	$\frac{5}{8}$ "	$\frac{5}{8}$ "	$1\frac{1}{16}$ "	"	"
4 "	$\frac{3}{8}$ "	$5\frac{3}{4}$ "	4 "	"	$\frac{9}{16}$ "	$\frac{7}{8}$ "	$1\frac{1}{8}$ "	$\frac{5}{8}$ "	$\frac{5}{8}$ "	$1\frac{1}{16}$ "	"	"
3 "	$\frac{5}{16}$ "	$4\frac{5}{8}$ "	4 "	"	$\frac{7}{16}$ "	$\frac{3}{4}$ "	$\frac{15}{16}$ "	$\frac{1}{2}$ "	$\frac{9}{16}$ "	$\frac{15}{16}$ "	"	"

For pipes cast vertically, y is to be taken as the minimum thickness of bell, and allowance for draught of pattern to be added.

THREE-WAY BRANCHES.

CENTRE OUTLET.

BOTTOM OUTLET.

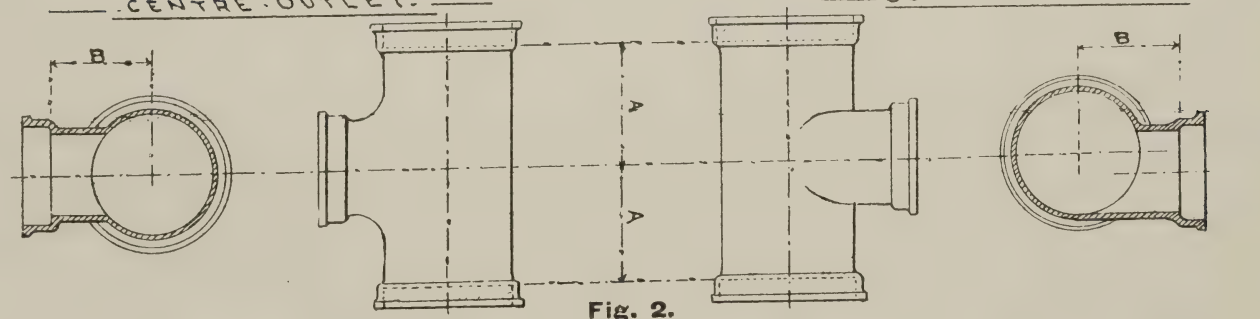


Fig. 2.

Table of Dimensions of Three-way Branches. (See Fig. 2.)

Size.	Thickness of Metal.	Distance A.	Distance B.	Weight.	Size.	Thickness of Metal.	Distance A.	Distance B.	Weight.
30x30	7/8 in.	25 in.	25 in.	2297	16x16	5/8 in.	17 in.	17 in.	722
30x24	"	"	24 "	2085	16x12	"	"	16 "	631
30x20	"	"	23½ "	2030	16x10	"	"	15 "	602
30x16	"	"	23 "	1917	16x8	"	"	14½ "	564
30x12	"	"	22½ "	1831	16x6	"	"	14 "	543
30x10	"	"	22 "	1802	16x4	"	"	13½ "	536
30x8	"	"	21½ "	1762	16x3	"	"	13 "	525
30x6	"	"	21 "	1741	12x12	9/16 in.	14 in.	14 "	406
30x4	"	"	20½ "	1730	12x10	"	"	13 "	384
30x3	"	"	20 "	1722	12x8	"	"	12½ "	336
24x24	3/4 in.	22 in.	22 "	1441	12x6	"	"	12 "	318
24x20	"	"	21 "	1362	12x4	"	"	11½ "	308
24x16	"	"	20 "	1246	12x3	"	"	11 "	296
24x12	"	"	19½ "	1167	10x10	½ in.	12 in.	12 "	294
24x10	"	"	19 "	1145	10x8	"	"	11½ "	259
24x8	"	"	18½ "	1108	10x6	"	"	11 "	242
24x6	"	"	18 "	1091	10x4	"	"	10½ "	233
24x4	"	"	17½ "	1080	10x3	"	"	10 "	222
24x3	"	"	17 "	1067	8x8	7/16 in.	10 in.	10 "	167
20x20	"	20 in.	20 "	1157	8x6	"	"	9½ "	159
20x16	"	"	19 "	1042	8x4	"	"	9 "	149
20x12	"	"	18 "	958	8x3	"	"	9 "	132
20x10	"	"	17½ "	927	6x6	3/8 in.	8 in.	8 "	98
20x8	"	"	17 "	895	6x4	"	"	8 "	91
20x6	"	"	16½ "	868	6x3	"	"	7½ "	82
20x4	"	"	16 "	857	4x4	"	6 in.	6 "	67
20x3	"	"	15½ "	847	4x3	"	"	6 "	43
					3x3	5/16 in.	5 in.	5 "	39

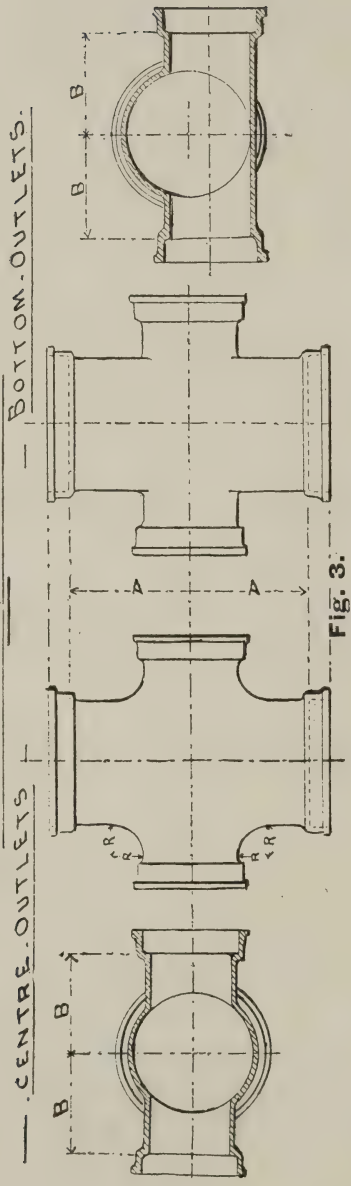
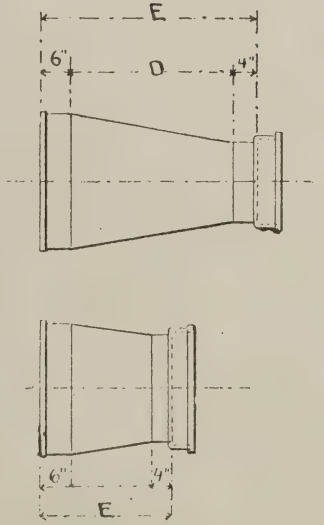

FOUR WAY - BRANCHES.
CENTRE. OUTLETS
BOTTOM. OUTLETS.
B
B
B
B
A
A
R
R
R
R

Fig. 3.

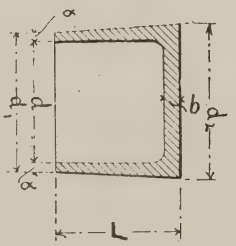
Table of Dimensions of Four-way Branches. (See Fig. 3.)

Size.	Thickness of Metal.	Distance A.	Distance B.	Weight.
30x30	7/8 in.	25 in.	25 in.	2883
30x24	"	"	24 "	2450
30x20	"	"	23½ "	2334
30x16	"	"	23 "	2120
30x12	"	"	22½ "	1950
30x10	"	"	22 "	1891
30x8	"	"	21½ "	1820
30x6	"	"	21 "	1780
30x4	"	"	20½ "	1759
30x3	"	"	20 "	1738
24x24	¾ in.	22 in.	22 "	1833
24x20	"	"	21 "	1678
24x16	"	"	20 "	1457
24x12	"	"	19½ "	1291
24x10	"	"	19 "	1213
24x8	"	"	18½ "	1165
24x6	"	"	18 "	1121
24x4	"	"	17½ "	1110
24x3	"	"	17 "	1041
20x20	¾ in.	20 in.	20 "	1478
20x16	"	"	19 "	1251
20x12	"	"	18 "	1081
20x10	"	"	17½ "	1028
20x8	"	"	17 "	947
20x6	"	"	16½ "	906
20x4	"	"	16 "	883
20x3	"	"	15½ "	863
16x16	5/8 in.	17 in.	17 in.	933
16x12	"	"	16 "	756
16x10	"	"	15 "	697
16x8	"	"	14½ "	623
16x6	"	"	14 "	581
16x4	"	"	13½ "	562
16x3	"	"	13 "	541
12x12	9/16 in.	14 in.	14 "	528
12x10	"	"	13 "	467
12x8	"	"	12½ "	395
12x6	"	"	12 "	352
12x4	"	"	11½ "	334
12x3	"	"	11 "	312
10x10	½ in.	12 in.	12 "	382
10x8	"	"	11½ "	312
10x6	"	"	11 "	276
10x4	"	"	10½ "	256
10x3	"	"	10 "	236
8x8	7/16 in.	10 in.	10 "	218
8x6	"	"	9½ "	181
8x4	"	"	9 "	162
8x3	"	"	9 "	145
6x6	3/8 in.	8 in.	8 "	128
6x4	"	"	8 "	113
6x3	"	"	7½ "	95
4x4	"	6 in.	6 "	89
4x3	"	"	6 "	58
3x3	5/16 in.	5 in.	5 "	51

REDUCERS.



PLUGS.



$b = 1.5\,\alpha$

DRIPS.

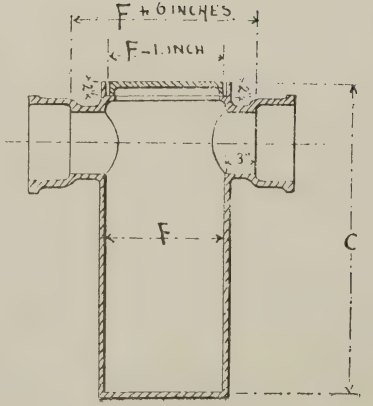


Fig. 4.

Table of Dimensions of Reducers. (See Fig. 4.)

Size.	Thickness of Metal.	Distance *D.*	Distance *E.*	Weight.
30x24 in.	$\frac{7}{8}$ in.	2 ft. 0 in.	2 ft. 10 in.	995 lbs.
30x20 "	"	3 " 4 "	4 " 2 "	1,046 "
24x20 "	$\frac{3}{4}$ in.	1 " 4 "	2 " 2 "	536 "
24x16 "	"	2 " 8 "	3 " 6 "	642 "
20x16 "	"	1 " 4 "	2 " 2 "	403 "
20x12 "	"	2 " 8 "	3 " 6 "	499 "
16x12 "	$\frac{5}{8}$ in.	1 " 4 "	2 " 2 "	263 "
16x10 "	"	2 " 0 "	2 " 10 "	287 "
12x10 "	$\frac{9}{16}$ in.	0 " 8 "	1 " 6 "	147 "
12x 8 "	"	1 " 4 "	2 " 2 "	167 "
10x 8 "	$\frac{1}{2}$ in.	0 " 8 "	1 " 6 "	111 "
10x 6 "	"	1 " 4 "	2 " 2 "	115 "
8x 6 "	$\frac{7}{16}$ in.	0 " 8 "	1 " 6 "	73 "
8x 4 "	"	1 " 4 "	2 " 2 "	79 "
6x 4 "	$\frac{3}{8}$ in.	0 " 8 "	1 " 6 "	48 "
6x 3 "	"	1 " 0 "	1 " 10 "	47 "
4x 3 "	"	0 " 4 "	1 " 2 "	29 "

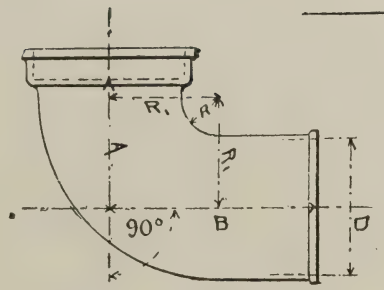
Table of Dimensions of Drips. (See Fig. 4.)

Size.	Thickness of Metal.	Diameter of Pot *F.*	Depth of Pot *G.*	Weight.
3 in.	$\frac{9}{16}$ in.	12 in.	2 ft. 6 in.	242 lbs.
4 "	"	"	"	252 "
6 "	"	"	"	266 "
8 "	"	"	"	300 "
10 "	"	"	3 ft. 0 in.	360 "
12 "	"	"	"	405 "
16 "	"	16 in.	3 ft. 6 in.	605 "

Table of Dimensions of Plugs. (See Fig. 4.)

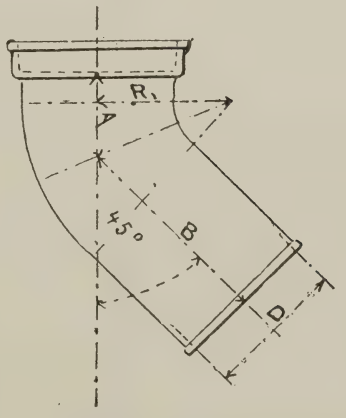
Diameter *d.*	Diameter d_1	Diameter d_2	Length *L.*	Weight.
30 in.	$31\frac{3}{4}$ in.	$32\frac{1}{8}$ in.	7 in.	408 lbs.
24 "	$25\frac{1}{2}$ "	$25\frac{7}{8}$ "	7 "	250 "
20 "	$21\frac{1}{2}$ "	$21\frac{7}{8}$ "	$6\frac{1}{2}$ "	183 "
16 "	$17\frac{1}{4}$ "	$17\frac{9}{16}$ "	6 "	105 "
12 "	$13\frac{1}{8}$ "	$13\frac{7}{16}$ "	6 "	65 "
10 "	11 "	$11\frac{5}{16}$ "	6 "	45 "
8 "	$8\frac{7}{8}$ "	$9\frac{3}{16}$ "	6 "	32 "
6 "	$6\frac{3}{4}$ "	$7\frac{1}{16}$ "	6 "	19 "
4 "	$4\frac{3}{4}$ "	$5\frac{1}{16}$ "	6 "	12 "
3 "	$3\frac{5}{8}$ "	$3\frac{15}{16}$ "	6 "	8 "

BENDS

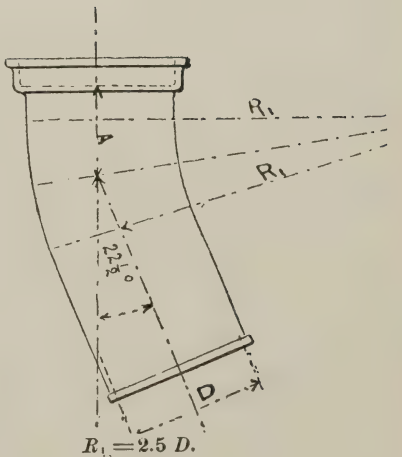


For full bends $R_1 = R + \frac{D}{2} + d$

For Radius R, see Table of Flange Bends.



$R_1 = D.$



$R_1 = 2.5\ D.$

Fig. 5.

Table of Dimensions of Bends. (See Fig. 5.)

Full Bend.						Half Bend.				Quarter Bend.			
Diameter of Pipe.	Thickness of Metal. *d.*	Distance *A.*	Distance *B.*	Radius R_1	Weight.	Distance *A.*	Distance *B.*	Radius R_1	Weight.	Distance *A.*	Distance *B.*	Radius R_1	Weight.
30 in.	$\frac{7}{8}$ in.	25 in.	42 in.	$22\frac{7}{8}$ in.	1553	17 in.	42 in.	30 in.	1580	17 in.	42 in.	75 in.	1630
24 "	$\frac{3}{4}$ "	22 "	36 "	$19\frac{3}{4}$ "	958	14 "	36 "	24 "	942	14 "	36 "	60 "	954
20 "	$\frac{3}{4}$ "	20 "	36 "	$16\frac{3}{4}$ "	788	12 "	36 "	20 "	769	12 "	36 "	50 "	778
16 "	$\frac{5}{8}$ "	17 "	36 "	$14\frac{5}{8}$ "	541	10 "	36 "	16 "	520	10 "	36 "	40 "	507
12 "	$\frac{9}{16}$ "	14 "	30 "	$11\frac{1}{16}$ "	288	8 "	30 "	12 "	285	8 "	30 "	30 "	284
10 "	$\frac{1}{2}$ "	12 "	30 "	$9\frac{1}{2}$ "	227	7 "	30 "	10 "	224	7 "	30 "	25 "	225
8 "	$\frac{7}{16}$ "	10 "	24 "	$7\frac{7}{16}$ "	122	6 "	24 "	8 "	109	6 "	24 "	20 "	119
6 "	$\frac{3}{8}$ "	8 "	24 "	$6\frac{3}{8}$ "	76	5 "	24 "	6 "	70	5 "	24 "	15 "	76
4 "	$\frac{3}{8}$ "	6 "	18 "	$4\frac{3}{8}$ "	57	4 "	18 "	4 "	57	4 "	18 "	10 "	55
3 "	$\frac{5}{16}$ "	5 "	18 "	$3\frac{13}{16}$ "	27	3 "	18 "	3 "	26	3 "	18 "	$7\frac{1}{2}$ "	26

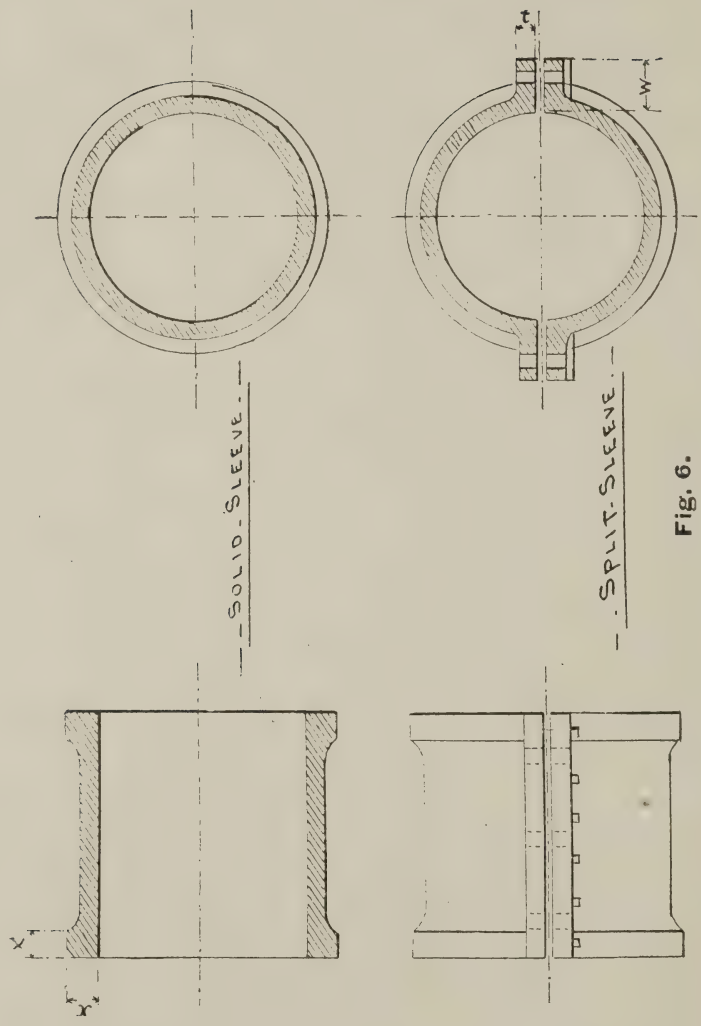


Fig. 6.

Table of Dimensions of Sleeves. (See Fig. 6.)

Solid Sleeves.							Split Sleeves.				
Diameter of Pipe.	Diameter of Sleeve.	Length of Sleeve.	Thickness of Metal.	Thickness of Bead x.	Thickness of Bead x_1	Weight of Solid Sleeve.	Width of Flange w.	Thickness of Flange t.	Number of Bolts Each Flange.	Diameter of Bolts.	Weight of Split Sleeve.
30 inch. . . .	33¼ in.	12 in.	1¼ in.	2 1/16 in.	2 5/8 in.	542 lbs.	4 in.	1⅜ in.	3	1⅛ in.	582 lbs.
24 "	26⅞ "	"	1 1/16 "	1¾ "	2¼ "	370 "	3⅜ "	1¼ "	3	1 "	406 "
20 "	22⅞ "	"	1 1/16 "	1¾ "	2¼ "	316 "	3⅜ "	1¼ "	3	1 "	352 "
16 "	18⅝ "	"	⅞ "	1½ "	1⅞ "	205 "	3½ "	1 "	3	¾ "	234 "
12 "	14½ "	"	13/16 "	1 5/16 "	1 11/16 "	145 "	3 "	1 "	3	¾ "	170 "
10 "	12¼ "	"	11/16 "	1 3/16 "	1½ "	103 "	2½ "	⅞ "	3	⅝ "	122 "
8 "	10⅛ "	"	⅝ "	1 1/16 "	1 5/16 "	76 "	2½ "	⅞ "	3	⅝ "	95 "
6 "	8 "	9 in.	9/16 "	⅞ "	1⅛ "	48 "	2½ "	¾ "	2	⅝ "	62 "
4 "	5⅞ "	"	9/16 "	⅞ "	1⅛ "	36 "	2½ "	¾ "	2	⅝ "	50 "
3 "	4¾ "	"	7/16 "	¾ "	15/16 "	24 "	2¼ "	⅝ "	2	⅝ "	33 "

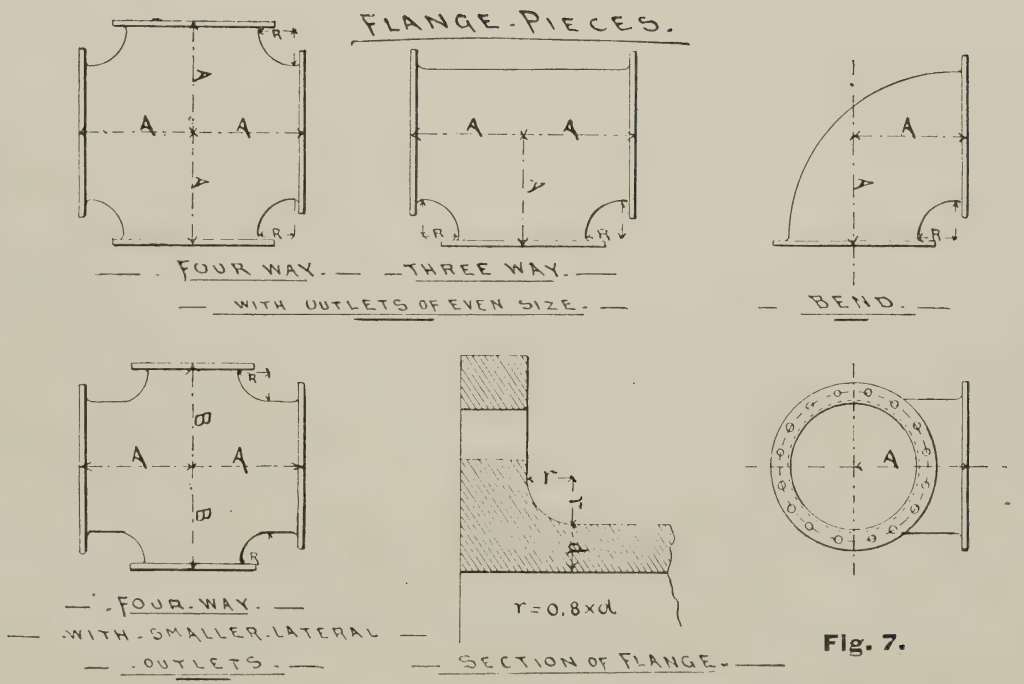


Fig. 7.

Bolt Holes to be laid out so as to straddle centre lines both vertically and horizontally. For dimensions *B* see Table of Bell-Four-Ways and Three-Ways.

Table of Dimensions of Flange Pieces. (See Fig. 7.)

Internal Diameter of Pipe.	Thickness of Pipe.	Thickness of Flange Finished.	Outside Diameter of Flange.	Diameter of Bolt Circle.	Number of Bolts.	Diameter of Bolt Holes.	Diameter of Bolts.	Length of Bolts.	Distance *A*.	Radius *R*.
30 inch	$\frac{7}{8}$ in.	$1\frac{1}{4}$ in.	$37\frac{1}{2}$ in.	35 in.	20	1 in.	$\frac{7}{8}$ in.	4 in.	25 in.	7 in.
24 "	$\frac{3}{4}$ "	$1\frac{1}{8}$ "	31 "	$28\frac{1}{2}$ "	16	$\frac{7}{8}$ "	$\frac{3}{4}$ "	4 "	22 "	7 "
20 "	$\frac{3}{4}$ "	$1\frac{1}{8}$ "	27 "	$24\frac{1}{2}$ "	16	$\frac{7}{8}$ "	$\frac{3}{4}$ "	4 "	20 "	7 "
16 "	$\frac{5}{8}$ "	$\frac{7}{8}$ "	$22\frac{1}{2}$ "	20 "	12	$\frac{7}{8}$ "	$\frac{3}{4}$ "	3 "	17 "	6 "
12 "	$\frac{9}{16}$ "	$\frac{7}{8}$ "	18 "	$15\frac{3}{4}$ "	8	$\frac{3}{4}$ "	$\frac{5}{8}$ "	$2\frac{1}{2}$ "	14 "	5 "
10 "	$\frac{1}{2}$ "	$\frac{3}{4}$ "	16 "	$13\frac{1}{4}$ "	8	$\frac{3}{4}$ "	$\frac{5}{8}$ "	$2\frac{1}{2}$ "	12 "	4 "
8 "	$\frac{7}{16}$ "	$\frac{3}{4}$ "	13 "	$11\frac{1}{8}$ "	8	$\frac{3}{4}$ "	$\frac{5}{8}$ "	$2\frac{1}{2}$ "	10 "	3 "
6 "	$\frac{3}{8}$ "	$\frac{5}{8}$ "	11 "	$9\frac{1}{8}$ "	4	$\frac{3}{4}$ "	$\frac{5}{8}$ "	2 "	8 "	3 "
4 "	$\frac{3}{8}$ "	$\frac{5}{8}$ "	9 "	$7\frac{1}{8}$ "	4	$\frac{3}{4}$ "	$\frac{5}{8}$ "	2 "	6 "	2 "
3 "	$\frac{5}{16}$ "	$\frac{1}{2}$ "	$7\frac{5}{8}$ "	$5\frac{5}{8}$ "	4	$\frac{5}{8}$ "	$\frac{1}{2}$ "	2 "	5 "	2 "

MR. A. C. HUMPHREYS :—There is one part of the report of the Committee on Education which was recommended by the Council to the Association, which has I think been overlooked, and on which it is desirable that action should be taken. I refer to the desirability of having this Association appropriate to the work of the Educational Committee the sum of $250 per annum, which is about the amount which they have been expending for the last three years. It is about that rate. This last year it was considerably less, but we were only working half the year. I feel that the Association is well able to continue to bear that part of the burden, and I ask that that sum be appropriated upon the recommendation of the Council.

MR. HARBISON :—I move that the sum of $250 be appropriated to the Committee for that purpose. (Carried.)

MR. W. H. WHITE :—I would like to say before leaving this subject of the Educational endeavor, and in reply to our friend from Hartford, that he seems to have overlooked the fact that this is an effort on the part of the Association to reach the young men employed in our gas works who are not able to go to Trinity College to get their education. I do not think it is a step in the right direction at this time for any of us to attempt to influence the Colleges in our cities to take up special classes in Gas Engineering, in opposition as it would seem to be, to the magnificent and excellent work which this committee has been doing for the past three years. They have done a great work in laying the foundation for what is before us, and I believe that this Association intends to thoroughly and heartily sustain the Council in their endeavor in this direction. As an Association we ought to take up this burden, and that it should not continue to be confined, as it now is, to ten or fifteen gas companies, and perhaps as many members; but every man in this Association should feel that it is his duty to extend these opportunities for education to the men who are associated with him. Many of them are not able to go to college; they have not the time and have not the means, and we are but helping those who are already practically working in this line. I strongly feel that this effort should have the active support of the members of the Association; that what assistance we can give in the way of money or effort should not be frittered away by trying to get any college to take up the work. Let us do it our-

selves and do it in our own way, and in a way that we feel will be for the lasting benefit of everybody interested in it.

MR. HARBISON:—I am very sorry that my friend, Capt. White, should for a moment think that what we have done in that line was at all in opposition to the work which the Committee of this Association has in hand. There is not a member of the Association who more earnestly wishes them success in the work they have undertaken than I do. I made the explanation I did, because I had not contributed, nor had the Gas Company with which I am connected contributed to this fund; we did not do so because we had already (and before this Committee was appointed) been making earnest efforts in the direction of having Gas Engineering taught in our institutions, and particularly in the college near my own home. No effort in this direction had been made by this Association at the time that I took the matter up with the Faculty of Trinity College. What we are attempting to do there, is not at all in opposition to the efforts of this Association. In many of the large institutions of learning, Electrical Engineering is a prominent study, as it is at Trinity, but in no one of them has the subject of Gas Engineering been even considered by the young men who are there getting an education. I claim that a college education does not unfit a man for the practical work of managing a gas works, but is of great assistance to him. If in his college course he can take up the subject of Gas Engineering in addition to his other studies, it will better fit him for occupying a position of responsibility. I do not want this Association to think that I have any object in view which is in opposition to this Association; quite the contrary. I wish them success—but I think that the Hartford Company is doing its share in the work which it had already entered upon before this Committee was constituted.

MR. SEARLE:—It may be thought by some who are not familiar with the work of this class that it is not educational for the older men. I have had the pleasure of assisting a few of the younger men in solving the questions given out by the Committee and I know that they would puzzle ninety men out of one hundred and I know that one of the solutions is worth $3,193 for any man to know!

THE PRESIDENT:—Next in order is the report of the Committee on Nominations, which Mr. Clark will read.

Mr. Clark read the following:

To the American Gas Light Association:

Your Committee on Nominations have the honor to report the following nominations of Officers to serve during the Association year, beginning with the adjournment of this meeting:

President, . .	ALEXANDER C. HUMPHREYS.
1st Vice-President,	GEORGE G. RAMSDELL.
2d Vice-President,	E. G. PRATT.
3d Vice-President,	WILLIAM R. BEAL.
Secretary and Treasurer,	ALFRED E. FORSTALL.

Members of the Council, to serve for two years:

ROLLIN NORRIS, MALCOLM GREENOUGH,
C. H. DUNBAR, S. J. FOWLER.

WALTON CLARK, *Chairman.*
H. C. ADAMS,
FREDERIC EGNER,
HENRY B. LEACH,
C. R. FABEN, JR.,
Committee.

On motion of Mr. White, Mr. Clark was instructed to cast the ballot of the Association for the election of the officers named. Mr. Nettleton acted as teller and reported a unanimous vote for the election of the nominees and the President declared them duly elected Officers of the Association for the ensuing year.

THE PRESIDENT:—We shall be pleased to hear from Mr. Humphreys.

MR. A. C. HUMPHREYS:—Mr. President and Gentlemen: I thank you for this mark of your confidence in me. I wish you to believe that I keenly appreciate the honor and it shall be my endeavor to so perform my duties that you may say that I have been worthy of you, and of my predecessors.

MR. WHITE:—If I am in order I move that the Committee on the next place of meeting be now named by the Chair.

THE PRESIDENT:—I think that is in order and if there is no objection to the motion I will name Mr. C. J. R. Humphreys, of Lawrence, Mass., Mr. L. L. Kellogg, of Sioux City, Iowa, and Mr. E. H. Jenkins of Buffalo, N. Y., as that committee.

MR. HARBISON: —Perhaps at this time it would be proper for suggestions to be made as to the place of holding the next meeting for the consideration of the Committee. I would cordially suggest that the American Gas Light Association hold its next annual meeting in the City of Hartford, in the State of Connecticut.

The Secretary read the following invitations to visit the plants indicated, at Niagara Falls and Buffalo.

From the Hon. T. V. Welch, Secretary of the State Reservation, tendering the free use of the Inclined Railway on the State Reservation at Niagara.

From Niagara Falls Hydraulic Power and Manufacturing Co.

People's Gas Light & Coke Company, Buffalo.

Cataract Construction Company.

The Buffalo Railway Company.

MR. NEAL:—I move that those invitations be accepted as far as practicable, and that the thanks of the Association be tendered to the parties offering them.

The President then read the following address, the Vice-President Mr. A. C. Humphreys taking the Chair:

PRESIDENT'S ADDRESS.

Gentlemen of the American Gas Light Association:

If during the reading of this address, you find that I refer very frequently to occurrences which have happened on the Pacific Coast, you must consider that my experience in the gas business has principally been gained there, and also that the conditions existing in that far away portion of the country are in a measure dissimilar to those existing here. You are all more or less able to interchange views regarding the conduct and management of your business. You are surrounded by fields of coal and oil. You have your manufactories of materials and appliances right at hand, and are better fitted in every way to manage and control the interests confided to you. It has been my good fortune to have had

the friendship of some of the brightest minds in the gas business, and to their kindness and friendship I attribute a great deal of my success in life. The feeling of fraternity existing among gas men is unique. I have never yet applied to any man in the fraternity for information or aid in my troubles in the business, and been refused. Their disposition to impart information and to help is one of the best sides of their characters. When I have attended the meetings of the different Associations throughout the country, I have listened to the reading of the papers with a great deal of interest, and to their discussion thereafter, but one of the greatest pleasures to me has been the intercourse and exchange of ideas with the members after the meetings.

I have made these few observations in advance because I believe that the time is near at hand when all the gas interests in the country will be called upon to strengthen and bind together the friendly feelings which now exist.

Within the last two or three years there has arisen throughout this country, a proposition looking toward the acquisition by municipalities of so-called public utilities such as gas and water works, street car lines, telegraph and telephone companies, in fact everything that necessitates the use of the public streets. A great deal has been said upon the subject by writers on political economy, and the recent Convention in Detroit of the Mayors of the different cities tended in that direction.

In the opening address of the President, Mr. MacVicar of Des Moines, he says, "At the threshold of the agitation it seems necessary as a preliminary measure to eliminate from our cities the private ownership of franchises for the monopolized use of the streets. The public must own and operate all plants for the supplying of light and water. Probably it should extend its powers so as to take in street railways, telephones, and other means of intramural communication."

T. S. Murray, Mayor of Denver, speaking upon the remuneration to cities for rights in, under and over public streets and alleys, says, "All the great public utilities of our municipalities should be retained in the hands of, and under the management of the people themselves, and no private corporation in any American city should have any more right to control the water we drink than the air we breathe. Many of the public utilities are, and must be, in the nature of monopolies. There can be no true com-

petition in the furnishing of water, gas, electric lights, telephones, etc., and tramways are entering the same category. They are no longer luxuries but actual necessities. The time should speedily come when all the great public utilities of our American municipalities will be owned and operated by the people themselves through the business administration of their municipal government."

Ex-Mayor Green of Binghamton, N. Y., was apparently the only one in the Convention who seemed to think that more light was needed. He urged that the private corporations be requested to send their best representatives to argue their side of the question; that a uniform system of statistics and accounts of municipal lighting plants be adopted. The reports on plants, he contended, were largely wrong. He called attention to Detroit's Lighting Commission's report in evidence of the fact that the plant was not a demonstrated economical success.

With it all the fact is undisputed that in the recent lease of the Gas Works of the City of Philadelphia to a private corporation, it has been shown that municipalities cannot and do not operate their plants as economically and as much for the interests of the citizens at large as corporations controlled by private individuals. It has been shown that if the same charges were made against municipal corporations as have been made against private corporations engaged in the same line of business, the cost of production and delivery would far exceed that of the company conducted by individuals. Under the present system of politics a corporation employing from 500 to 1,000 men could be made one vast political machine which could be made to help to control the politics of a city, or at elections men could be employed in the various departments to swell the number of voters. Does anybody believe that it can be managed profitably or economically in that manner? Anyone who has seen work done on the public streets of a city or observed the manner in which public offices are conducted, would not hesitate for a moment to say that he would not permit that character of work to be done in his own private business.

Mr. Josiah Quincy, Mayor of the City of Boston, in a recent letter to the City Council, has advocated the granting of a ten years' contract for lighting the public streets to a private corporation, and expresses his views that the uncertainty of the operation of a municipal plant has decided him to recommend that the lighting be done by a private corporation.

Great Britain has been most frequently cited by persons interested in promoting municipal ownership, but so far I have not seen any statement which shows that consumers in those cities are getting their lights any cheaper than those in cities of the same size supplied by private corporations. As an instance of which there is an article in the Journal of Gas Lighting of Sept. 20th from the report of the Sheffield United Gas Company, where the President, Sir F. T. Mappin, compares the reduction of the price of gas at Sheffield with that of Birmingham and Nottingham, drawing the conclusion that Sheffield gas consumers have been more fortunate in deriving their gas supply from his Company, than the consumers in other large towns where the works were in the hands of the corporations.

At this particular time and in this particular place, where the greatest long distance transmission plant in America is in operation, it will not be out of place to say that a great deal of alarm has been felt by some gas companies regarding the transmission to long distances of electricity generated by water power. The experience so far has been that, while in some instances it has worked a very great hardship on companies operating small plants, the cost of equipping and maintaining an electric plant for long transmission, the high initial voltage required, the line and converter loss sustained, the high cost of constructing storage dams to insure a full supply of water during a dry season, have caused this system of lighting to be looked upon with more or less disfavor. This has been practically illustrated this year in California, notably in the City of Sacramento, the Capitol of the State, where the Capitol Gas Company was conducting the business of selling gas and electricity. The Folsom Water Power Company, aided by the State authority, was given the right to construct a dam across what is known as the American River, just above the State Prison at Folsom, the Electric Company granting the State the right to use a sufficient quantity of water to generate 1,000 horse-power in the State Prison grounds, to be used for working the machinery in the prison and quarries, and also for lighting the prison and adjacent country. The water was then taken through a long flume to the town of Folsom, where it had drop sufficient to generate electricity for supplying the City of Sacramento. In consideration for the use of this water the State authorities agreed to supply all the prison labor which would be neces-

sary to build a dam and canal to Folsom, and yet with this immense saving they were still unable to pay the interest on their bonds or make one cent of profit out of the business. Another company also came in from the South Yuba River, about the same distance from Sacramento, and entered into competition with the Folsom Company and the Sacramento Gas Company. These people have also been unable to pay any interest to their stockholders, and while the Sacramento Gas Company has lost a large percentage of its business and has not succeeded in paying a dividend, still it has managed to pay expenses in spite of the cheap light furnished by water power, and is in as good condition to-day as are its competitors. The outlook for the electric people this year has been very bad for the reason that the season has been very dry. They have not been able to secure sufficient water to run their machinery and they have been compelled to erect at a large expense, an auxiliary steam plant, and in my judgment it is only a question of time when they will have to be placed in the hands of a receiver.

In the small city of Fresno similar conditions exist; the people have been left without light and the mills which were dependent upon the Fresno Co. for their supply of current for motor purposes, have been compelled to shut down and discontinue the use of electricity entirely and return to steam. Can anyone of you in this Convention conceive the possibility of a gas plant being shut down for any cause? People have become so accustomed to the continuous and uninterrupted service of gas, that were we at any time for any reason to shut down the supply, a howl of indignation would arise.

In examining into this question of the Sacramento Gas Company, I found a great many things which, as a gas man, attracted my attention. In the first place the original installation was very expensive and there was a great deal of wear and tear on the turbine wheels and motors; then the quantity of copper necessary for the pole line, the constant care and watchfulness required to keep it in order, the liability of a short supply of water, the line loss and the equipment of sub-stations have made it so very expensive that it is almost impossible for them to sell electricity at the same rate at which gas is being sold and make any profit. I therefore judge from my observations that long line transmission will not at present hurt the gas business.

The introduction of electricity in the present commercial form has not proven the great evil anticipated. It has caused, in a way, a demand for the use of much more light than formerly, but above all it has compelled the gas man to find new outlets for the sale of his commodity. Gas as a fuel is now recognized as one of the most economical agents in the world. It is being used by thousands of people in their houses for lighting and cooking, and in addition to these, we find other uses for it every day. In San Francisco, where hundreds of thousands of cans are made every year for packing fruit and vegetables, gas is almost the only agent used for fuel in their manufacture, one company alone having asked us to make a bid for ten million feet per annum for that purpose. We have also found that jewelers and metallurgists use it not only to their advantage but to their comfort.

One of the most successful ventures of the Company which I represent was the buying of gas ranges and loaning them to people free of charge, provided that they used not less than 1,000 feet of gas per month while they had the stoves in their possession. A great fear that we had at that time was that the stoves would be returned by customers in such bad condition that it would absorb all of the profits to put them in repair again, but much to our surprise we found that the stoves came back in very good shape, and with a little management on the part of the people in charge of that department, the business has steadily grown and has proven to be a most valuable adjunct in selling gas. If the intelligent gas manager will take hold of the different appliances for the use of gas outside of illuminating purposes, he will be surprised to find the number of avenues by which he can dispose of large quantities of gas at a profit.

The gradual decrease in the price of gas has shown that great intelligence and application have been used in its production and sale, and judging from the reports of the increased output of gas and from the quotations of the stock of the different gas companies in the stock markets, it must certainly have been not only a wise but a paying venture to put the price at such a point that it could not only be used for lighting but also for fuel and heating purposes.

I am very glad to see in this connection that the question of inclined retorts has been taken hold of so seriously by the Association, and been discussed so thoroughly. I must say that I was

very much impressed by them when I was in Vienna; not only the apparent saving in labor but also the ease with which they can be handled, although I do not think that they are used there to the best advantage. Also in connection with labor-saving appliances, I have been very much surprised that more attention has not been paid to the question of reviving oxide of iron in the purifying boxes. That this can be done there is no doubt and I am sure that there are one or two witnesses present who will testify to its efficiency and economy.

The question of the utility of acetylene as a commercial product has been debated from time to time by members of the gas profession and while gas men have been disposed to regard it as too dangerous, especially in a liquid form, to be used with impunity, still there are others who believe that the product will be materially cheaper in time, and think it can be used with safety and economy. So far it has never been demonstrated that it can be used on a large scale, but it is reported that Mr. Charles F. Dietrich is about to put in operation a plant for its distribution on a much larger scale than has heretofore been attempted, and I think all the gas men will look with great interest to this as a matter touching their own welfare.

It seems to me that the recent agitation on the subject of municipal ownership of public utilities, by the Mayors of the different cities, should be a lesson to gas managers showing the necessity on their part, of some concerted action to combat the theories which are put forth by these men who have only in a general way studied the subject, and with which they are not absolutely familiar. For instance, we find a law in one state which will in a measure protect a gas company, while in another state there will be laws which are not only a burden, but which will work a great hardship on a corporation. If the parties interested took the same interest in the matter as do those who are opposed to us, I am sure that we could better our condition very materially. I would suggest that if it is the pleasure of this Convention, a committee be appointed to discuss this matter, and if in their judgment they see fit, to make a recommendation to the next convention of the things necessary to be done to accomplish this end. My own experience has been that we are constantly assailed by every petty legislator who has an ax to grind, and by every news-

paper which aspires to be popular with the people or has other reasons.

This was illustrated very plainly in the recent attack made upon the San Francisco Gas and Electric Company by the daily newspapers, for political reasons, when they brought up the old bugaboo of carbon monoxide. They succeeded in having the matter brought not only to the attention of the City authorities but also before the Board of Health, but I am glad to say that these gentlemen, on the showing made by us, took the view heretofore expressed by other Boards of Health, so that now I hope this will be the last the gas man will have to hear of carbon monoxide and its deadly qualities.

The recent improvements in the propulsion of street cars by electricity has brought back to my mind, that when electricity was first used for that purpose, the gas men throughout the country were alarmed for the safety of their street mains, owing to the electrolytic action upon the iron. San Francisco was one of the cities first to adopt the electric roads, and in a very short time we began to feel the effect of the electric current. We found that within a comparatively short time after their introduction, our mains and services showed unmistakable signs of electrolysis. In order to arrive at the extent of the possible damage and the effect that it was having on our underground services, we immediately employed two expert electricians and a large number of assistants and made a very thorough and exhaustive test. We found that one of the roads, which had been very badly constructed, was giving us an enormous amount of trouble and causing great expense, and the managers of the road, upon becoming aware that we were making this investigation, immediately began to rebond their rails throughout the entire line, showing that the original work had been very carelessly constructed. The result was, that while we still had trouble, it had been lessened to a great degree. Subsequent to that, other roads adopting electricity as a motive power, had their bonding done in a more thorough manner, and we, not finding the same amount of damage being done, began to feel that our fears of electrolysis were unwarranted; but after the experience of some years we find that the same deteriorating effects have been going on all the time, but in a lesser degree.

That this process of deterioration will constantly go on is shown by the following extracts from the report made to us by our electrician. "Everywhere along the line of an electric railroad where the track is positive to the pipes there is leakage of current to the pipes. This is generally small in amount in most places but the sum total of all the leakage currents along the line of a road of any considerable length will be very large, and no practical system of surface track construction will be adequate to prevent such leakage. Although the leakage is generally small at most points, yet experiments show that at frequent intervals there are paths of comparatively low resistance through the soil, and at such places the leakage is very much above the normal.

"Where the wires from the negative poles of the dynamos are connected to the track, the potential of the track is lowered, with the result that throughout a region of greater or less extent, depending upon the circumstances, the pipes will be positive to the track. All the current which leaks to the pipes where the track is positive will flow to these regions where the pipes are positive, and as these regions are relatively of small extent the volume of current in the pipes will become very great. This current must return to the dynamos and to do so must pass through the ground to the track. This passage of current from the pipe to the rails through the moist earth will unquestionably cause corrosion of the pipes by electrolytic action. This corrosion would be very slow and distributed in proportion to the potential difference between the pipes and track, if the resistance between track and pipes were everywhere the same, but as above noted, the experiments demonstrated that at frequent intervals the resistance is much less than the normal and consequently at such places the flow of current, and hence the corrosion, will be much greater than the average. In fact the existence of such points will tend to protect places in the neighborhood.

"Throughout the entire region where the pipes are positive, such points will be found where corrosion is steadily going on and while it might not be manifested by the giving way of the pipes within three or four or possibly more years, yet where they did begin to give way they would be found very much weakened in many places, and in the case of the water pipes the application of the pressure after one place was repaired would possibly cause other places to give way.

"Corrosion throughout the danger regions is far less than one would suppose, yet it is steadily going on and may be expected eventually to cause much trouble unless means are taken to prevent it. Probably it can never be entirely overcome, yet it may be so far minimized as to be practically removed as a source of serious danger."

Recently several of the places have taken up the discussion, notably Spokane Falls, where the damage done to the pipes of the Gas Company was so great that it necessitated the bringing of a suit by the Spokane Gas Company against the Railroad Company. This suit is now in the courts and its decision will be important to us all.

A question asked one of their electrical experts was: "What effect, if you know, does electricity escaping from the rails into the earth have upon gas mains constructed of cast or wrought iron which are embedded in the earth, and which lie within ten feet of the rails?"

The answer to which seems very clear: "The rails with their bonds and ground wires offer a certain amount of resistance to the return circuit, as stated before, which is dependent upon the size of the rails, the dimensions and arrangement of the bonds, ground wires and perfection of their connection, as well as the volume of current carried and the distance to the generating station. If this system of rails and ground wire lay within ten feet of the system of cast or wrought iron, gas mains, running parallel to same, both being imbedded in the earth, and these gas mains, through their cross connections at intersecting streets, which in turn are connected with other lines of mains in parallel streets, would form a net-work of piping that would have a metallic area many times greater than that laid out in the main return system of the electric road and form a route more direct and of less resistance for the return current. These gas mains being separated from the rails by a few feet of damp earth, wet gravel or other material, which is in itself a very poor conductor, and a small sectional area would offer a very high electrical resistance, but when its great area of contact, both against the surface of the rail and the gas mains is taken into consideration, and the relative short distance, say ten feet, through which the current is transmitted, it forms a conductor which allows a considerable portion of the main current to find its way to the gas

mains and other conductors of low resistance and follow them to a point where there is a lower voltage upon the rails or some other substance that forms a portion of the actual return system; this causes the return current to leave the gas mains and follow the new route of lower resistance, and whenever a current of electricity leaves one metallic mass to pass to another through the earth, which owes its conductivity to moisture contained therein, a chemical action takes place where the current leaves the metal surface and a gnawing away or corrosion is produced which rapidly eats away the metal at these points. This action takes place under the above-mentioned conditions, even where the difference in voltage is so low as not to deflect the needle of an ordinary station volt meter."

In this country we are not protected by any laws or regulations which will cause the railroad companies to take care of their own surplus current, but in England the Board of Trade intervenes with a set of regulations on the subject, and the *Journal of Gas Lighting* quotes Professor Rucker as saying: "We are now at the beginning of another industrial epoch which may indeed, if power is transmitted from a distance on a large scale, brighten our skies but which threatens to saturate the earth beneath us with electric currents. That these may interfere with the general comfort is evident from the injury which has been done to underground pipes at Washington and elsewhere." The subject was subsequently discussed at a joint meeting of Physicists, Engineers and Magneticians. It appeared, from what was stated on this occasion, that magnetic observatories succumb to electric railways within three miles. In the case of a proposed electric railway at Kew, the magnetic observatory is to be protected by complete insulation throughout the district, and the two conductors are not to be separated by one-hundredth of the distance of either of them from the observatory. Mr. W. H. Preece spoke of the need for making electric lighting and traction currents, as the latest comers in the land, subservient to regulations in the interest of the safety of older public service appliances. Taking the case of the City and South London Railway, upon which a very close watch has been kept, Mr. Preece says that the whole of London had been found disturbed by the currents of this Railway. There seems to be considerable leakage "due to the use of the earth, and also to the fact that the third rail, from which the cur-

rent was picked up, was badly insulated." He called special attention to the fact that "in no single instance was the disturbance such as could not be remedied by taking simple and ordinary precautions." This is reassuring; but the question remains as to what is likely to happen if these precautions fail. If ever the Metropolitan Railway is worked electrically it will be necessary to make it a complete metallic circuit. "The use of the earth is a vested interest for the whole nation," and electric tram-ways and railways must not monopolize it.

The recent plan of the Educational Committee of raising a fund to educate young men in the various branches of the gas business, should be fostered and helped by every member of this Association. The people in all other similar lines of business are very particular that the young men coming to them should be educated in their different professions, but heretofore the gas man has taken his men from his works, and has given them a good practical training, but they have not been given the technical advantages which every man in our profession should have. These young men should not only be drilled in the practical parts of the business, but they should be taught its chemistry and above all its economies. A practical gas man should understand the keeping of accounts; he should have his statistic books so that he can refer to them from time to time and see the value of his results, and he should compare them from year to year and see if he cannot do a little better all the time. In this way, if this Educational Society will take up the different subjects and get the younger members of the profession to work at them in an earnest and thorough manner, you will find that your records of cheaper gas will continue to increase and the efficiency of your works to enlarge in proportion. Therefore, I say that it is the duty of every member of this Association to foster and help the plan of the Committee to push the young men to the front, and when they are there they will be competent in every way to take charge of the business confided to their care.

In the *Progressive Age*, of October 1, 1898, you will find a very interesting review of the proceedings of the Society for the Promotion of Engineering Education, which says: "The subject of Gas Engineering is usually taught as part of Chemical Technology in the Department of Chemistry, and there it stops. In some of the Metallurgical Courses the subject of Gas Producers is briefly treated

of, but the general subject of gas works engineering is almost ignored notwithstanding its industrial importance; this is not because the business does not require intelligence, in fact it is entirely the reverse, as can be testified by those who have taken up the subject of residuals, by-products, the investigation of contemplated improvements or of new processes. The reason why some companies produce gas at a cost of sixty cents and over is not always traced to high price of coal. In the paper on Engineering Chemistry the fact was brought out that but three institutions paid particular attention to that subject. Although it is not a striking recognition, yet it may be considered a decided step in the right direction. By bringing such subjects up for discussion the society is doing a good work, and it is to be hoped that when they are developing Engineering Chemistry they will not neglect that of Gas Manufacture."

It has always been a surprise to me that the vast industry of Gas Manufacture, representing millions of dollars of capital, has not been more particularly recognized by the technical schools of the country. As far as I know there are very few technical or scientific schools where there is a course devoted to Gas Manufacture; considering the influence represented by such an immense amount of capital and so large a number of intelligent men, it seems strange that no steps have been taken heretofore to have embodied in the course of technical studies that of the manufacture of gas.

In conclusion, gentlemen, I would say that the future of the gas business looks exceedingly bright. The increased output as shown by the reports of the different companies, the general interest taken in the gas business, the value of the stock which is regarded as one of the most reliable securities in the market, indicate that the business is on a firmer basis than ever before. The decrease in price and the increase in candle-power have led to a greater demand for light, although gas can hardly be regarded any longer as a luxury but as a necessity.

Gentlemen of the Convention, while I have had the pleasure of meeting a great many of you, still at this moment there is quite a number present whom I have not had the pleasure of meeting heretofore. I want to thank you all for the honor which you conferred upon me at your last meeting, and to say that I appreciate most highly the distinction of having been selected as your presid-

ing officer, particularly as I have not been able to see as much of you all as I should like to have done, owing to the great distance and the consequent amount of time necessary to be devoted to travelling back and forth to attend the Conventions, but I sincerely trust I shall be more favored in the future.

THE CHAIRMAN:—What action shall be had on the President's address?

MR. BOARDMAN:—I move that the President's admirable address be referred to a committee of five, to be appointed by the Chair, to report at a later session such recommendations as to them seem proper.

The motion was carried and the Chairman appointed as such Committee: A. E. Boardman, John Mc Ilhenny, David H. Geggie, B. E. Chollar and John M. Rusby.

The Association then took a recess until 2 P. M.

AFTERNOON SESSION.

The Association met at 2 P. M.

THE PRESIDENT:—The Chair will appoint as the Committee to award the Beal medal: M. S. Greenough, William Henry White and A. E. Boardman. The terms of the gift require that the Committee shall be appointed from among the past Presidents of the Association.

The Association will now listen to the reading of the paper by Mr. Henry L. Doherty, entitled "How Can We Make the Use of Gas for Cooking More Universal?"

(For Paper see Appendix, page xli.)

THE PRESIDENT:—I think Mr. Searle has had some experience in this line and that he can enlighten us.

MR. SEARLE:—Mr. Doherty starts out by attributing the reason why gas is not more generally used for cooking to a "lack of appreciation on the part of the public of the general merits of gas" used for that purpose. That leaves little room for argument that such lack of appreciation be due to their ignorance; right here is where the canvasser comes in with advantage, and it is undoubtedly the canvasser who wins the day.

"General belief that it is more expensive than it really is." That belief is due to ignorance, and there again is where the canvasser can do good work.

"Procrastination." I come from a country where people carry procrastination in their hip pockets, and I pass that over.

"The cost of making installation." That depends largely upon territory, upon the way you treat your customers and whether you can make the cost to them or to the company. We have had many satisfactory monuments of success in free installations, and I think the most magnificent record ever made by any gas company in this country was made by one of the large gas companies providing absolutely free installation—by doing everything on earth that a gas company could do without letting the consumers dip into their pockets.

"The use of incomplete or unsatisfactory gas stoves." Most of the gas stoves as now made are complete and satisfactory. If you have an incomplete gas stove, the place for it is on the scrap heap. If you have sold such a stove to a consumer, you have done him an injustice, and it is no more than right that you should right yourself by giving him another free of charge. Gas stoves as now made become unsatisfactory only through misuse or because of ignorance on the part of the consumer or because they have become plugged up for want of cleanliness. We have a very serious thing to face in the effort to keep gas stoves in order. Where I am we have four thousand stoves in use and it keeps from five to seven men busy keeping those in order. That cost must be figured in as an item in determining the cost of installation, and it is a very important figure. We assume that a consumer will not use a stove that is not in order, and that we must put it in order. The result is that those expenses must go into the estimation of the cost of gas at the burner. Undoubtedly it is the duty of the company to repair it. There is no object in giving to the consumer a gas stove at a cost of $25 which earns only six per cent. on the investment for a year or two and then throwing it aside. To offset the first investment, it must run for fifty or sixty years and then be handed down to our children, particularly if we wish to go on in the future increasing our business.

"Fear of the gas stove." If this fear cannot be overcome in the older people, it can be in the younger by proper schooling and demonstration. I am very earnest in my argument for cooking

schools in connection with the public schools. Although we have women's clubs and the "new woman," we may be sure that woman is always going to be womanly. She cannot change her sex to save her soul. She will be a good cook all her life. Since the tendency now is to be a *home* woman and not to depend so much on servants, but to understand for herself the duties of the kitchen as well as the finances of the household, it is certainly very beneficial to have an education in this line in childhood. If we look ahead for twenty years we shall see that all these young ladies are to become wives and there is no reason in the world why they should not be good cooks and use gas stoves.

"Dislike to abandon the use of a good coal, wood or gasolene stove." The only way you can get them to abandon it is to give it away. That is, where persons are reluctant to abandon a coal, wood or gasolene stove, you had better take it away and give them a new stove, and so wipe out that last gray hair.

We are certainly unable to supply hot water in a satisfactory manner. We have heaters which are efficient up to 70 per cent., but even then it is an expensive affair, and invariably, where they are used you will find that if the bill for cooking is, say nine dollars per month, five dollars of that is for the water heating. I have never yet seen a free installation which would not work to our advantage. I have received results of thirty thousand gas stoves, and the dividends that are declared by those companies are enough to warrant the assumption that cooking by gas is a good thing. Mr. Doherty covers the ground so well, and so thoroughly answers his own questions that it is difficult to find any fault with the paper itself, but as a discussion-provoking paper, I think it "takes the cake." We have lots of people here who are interested in the use of gas for cooking, who do not believe in it, and as Mr. Doherty does not believe in parts of his own paper, we ought to get this floor red-hot with discussion in a few seconds.

Mr. Doty:—The question is one of methods, of ways and means, and as usual with these questions, the results of individual experiences are of value to the Association as a whole. The subject admits of discussion, using the word in the sense of debate, from the nature of the question—"How can we make the use of gas for cooking more universal,"—for it is believed there are nearly

as many methods as men, and individuality if brought forward prominently for persuasion is an important factor of success.

If there be a lack of appreciation of the real merits of gas for cooking, let us persuade those who are in error, by education. Right here I feel that I would take the position that a house-wife who is not sufficiently alive to the real merits of gas for cooking, and in a position to use gas, is not worth the education; but this is extreme, and progress with some is slow, and progress is only possible when work is unfinished. If there were no further field for effort what would become of our comparative statements with the increase column always in sight and waiting to be filled—the ever-present spur of management. Education by advertising, by demonstration lectures is good, but I believe a more powerful means of ultimate success is found in the public school kitchen, and where gas for fuel is used in demonstration, the girls have an object lesson, where convenience, cleanliness, comfort and economy are in evidence. It is to our interest to encourage this school kitchen work. Likewise the private schools or classes of household economics, domestic economy, cooking clubs or whatever name these associations of ladies may take, should be encouraged by our interest. Our future lies in the housewife who studies the subject, and we want the idea to get abroad that gas for fuel is up to date and that everybody who is anybody uses gas for fuel.

Further than this, I have placed a range in an intelligence office, and under arrangement with the proprietress, the servant girls while waiting for employment are instructed in gas cooking. We also gave them *Marion Harland's* "Cooking by Gas," to read, and we find the plan works well. The time is fast approaching we think, when the living-out girls will not take a place in a kitchen where gas is not used for fuel. These cook books are a sign of the times, for while the former directions were, "to sit on the stove and stir constantly," now it is "to sit on the gas stove and stir constantly;" anyhow, gas has stirred things up and we are the gainers.

It is undoubtedly true there are mistaken notions of the expense attached to the use of gas for cooking. Gas in the hands of careless servants runs into money fast; in the hands of the careful housewife the bills are cut in two. If the mistress could arrange an allowance system, so much for gas, and you must do the work or go back to coal, I imagine many a servant would practice

economy. Here we can encourage the mistress by instructing her in the mysteries of reading the meter, and if she will take daily readings I guarantee the bills will come down. Mrs. Rorer says: "gas must be mixed with brains."

"Procrastination is the thief of time," but even here gas helps, for gas saves time. We should persuade procrastination when thieving to "take time by the forelock."

I advocate free services and fuel connections. I do not advocate free ranges—I believe the gas range gives value received, and ultimately is most appreciated where obtained by purchase. Last spring we had a motto competition in our city, and offered prizes for the most suitable motto to be used in advertising gas ranges. The first prize was $5.00, and the interest was general. The motto which won the award, "Measure for Measure—a gas stove for your money," best expresses my position on this point. We sell ranges above cost, the average price being 25 per cent. above cost; we deliver and connect ranges free whether purchased at our salesroom or at the local stove stores; we encourage the local dealers to handle gas stoves by paying $4.00 commission for each four-hole range sold, other stoves proportionately. They sell at the prices fixed by us, and make the commercial profit. The commissions we pay to them they spend in whole or in part in advertising. The arrangement is mutually satisfactory. We employ five solicitors, each in allotted territory, and pay them a commission of $5.00 for each range sold. We have an extensive appliance department for the sale of fixtures, Welsbach lights, both for inside and outside lighting, Backus Heaters and gas appliances generally, and on all these the solicitors receive commissions on orders. By these means the solicitors make a good living all the year. As a result of this method of handling ranges I would state the outside dealers sold this year to date 170 ranges, the solicitors sold 215, and we sold from our office 250, a total of 635 ranges; in addition 321 two and three burner hot plates were sold, a total of 956 gas appliances for cooking installed this season; an encouraging result I think, and one which is giving satisfactory returns in gas sales, the increase for the past three months being 14 per cent. The appliance department will show no profit, but will pay operating expenses, which includes advertising, rent, light and heat, and the salaries of three permanent employees, one of these a young lady, who investigates complaints, follows

up new users of gas, gives instruction in the economical management of the range and gives demonstrations during the summer season at our office on the 14th and 15th of the month, these being the heavy discount days. At these times we serve luncheon from noon till five o'clock in the afternoon, giving the ladies who call, palatable as well as ocular proof of the pleasures of gas cooking. We have served as high as 300 ladies during one of these afternoon luncheons, and that they are popular goes without saying.

Gas stoves to-day are generally satisfactory and economical in operation, and show many improvements during the past few years. A sign of the times is the getting together of the manufacturers for mutual interest. The expressed desire for uniformity in stoves, in other words the standardizing of the stove, would seem to indicate the manufacturers regard further improvement limited.

I take exception to the wisdom of not encouraging the adoption of the hot plate. If for no other reason than a means to an end, its use should be encouraged. The hot plate is the engagement ring, the promise of the day when the wedding of the housewife and the range will come. The use of the portable oven with the hot plate should be encouraged, for with these two, excellent and satisfactory cooking can be done. Broiling can be done by the method known as pan broiling, a good deal better way of cooking meats than frying, so common in practice.

Hot water heating is important, but we have found a satisfactory water heater, and with the many minds at work on the subject success will come. The combination heater and thermostat is a step in the right direction.

The garbage question has some bearing on the subject, but the disposal is a question of ways and means. With coal or wood there are the ashes, dirt and dust, the disposal of which is much more troublesome. But little kitchen refuse is combustible; no matter what fuel is used, the cans, bottles and other junk must be carried away, and in the cities the strictly so-called vegetable and animal garbage is carried away by the city department.

The heating of the kitchen in homes already built without provision for other heat than from the kitchen range, certainly retards all the year use of gas for cooking; but modern construction recognizes the utility of gas by making provision for heating by furnace or stove heat, and many apartment houses in the large

cities have no other than the gas range, an encouraging sign from the owners and architects who are up to date.

Gas companies to-day must advertise. Advertising in the abstract is a tax on business, a premium against competition, but as business is conducted by successful merchants, so we, having a merchantable article, must conduct our business. Successful merchants advertise and we get in with the procession. How to advertise successfully, how to build business is a problem—the subject of books. Gas men, technical men, have not always the talent of expression, have not the pen of a ready writer and are thus handicapped in the struggle. I have thought much energy could be saved by having a central advertising bureau for the supply of suitable matter for printers' ink, where all would have the advantage of trained minds in the campaign of education. This suggestion was made several years ago to one of the gas journals. This year we have contracted with an advertising bureau in New York for cuts and descriptive matter to be furnished weekly, and I think the results satisfactory. In computing the value of newspaper advertising we must remember the circulation is both urban and suburban, the latter often exceeding half the total issue. Street car advertising I have tried successfully this summer, and will probably use this means next summer. But after all it is the personal solicitation, the getting together of individuals, the persuasive power of the company's salesman, himself convinced of the merit of the selling value of his product, which brings this product into the home and kitchen. Gas for cooking is all right, and it is here to stay and grow.

Mr. Egner:—We have with us to-day a young man from the South, from Portsmouth, Virginia, who has been most successful in the introduction of gas for cooking and heating: Mr. H. H. White. I think he can be induced to give his experience at Portsmouth.

The President:—We shall be glad to hear from Mr. White.

Mr. H. H. White:—I am very much interested in this subject, but Mr. Egner is mistaken about my success in introducing gas for cooking; I have been successful in introducing gas for heating, and especially for heating churches. In our town seven of the largest churches are heated exclusively by gas. We are using the No. 10 gas radiator. I am fitting up three churches this week,

which leaves only four churches in the town that are not heated by gas. I have been very successful with gas radiators in every way, but not quite so successful with gas cooking stoves. We have put out about sixty stoves, but have been compelled to use personal solicitation in every case in introducing them. In most cases they stay out, but some of them have come back, but we keep at them. I do not think of all the stoves we have put out, we have taken more than four back, and these in most cases for non-payment. Considering that we have only been working the fuel business for the past five years, we feel very much encouraged. I have a statement here of the consumption of gas by these different churches, and the amount of money paid by them. In one particular instance we are saving them, over the former system of heating, about $140 per year; this church is about sixty-five feet long, forty feet wide, and will seat about four hundred people. Before we put in our gas heating arrangement they had paid the sexton $240 per year for his services and their fuel bill was $60 the year before we put in gas. The installation of the radiators cost them about $125. They reduced the Sexton's salary ten dollars per month, making a saving of $120 per year. Their gas bill for three years in succession has never been over $42. This is on a special fuel meter.

MR. JENKINS:—What is the price of the gas?

MR. H. H. WHITE:—It is $1.25. We have in one case twenty-two No. 10 radiators, and on two or three occasions they have burned from $40 to $60 worth of gas per month. I will say in that connection incidentally that we have an instantaneous water heater for heating the pool, and that on one or two occasions where consumption was excessively large, I have charged them a dollar. I did not charge them their rate, but they did not know the difference. The bills were so large that I was a little anxious about it, and made them the dollar rate. The pool was heated very successfully with the water heater, and the gas radiator was also very successful. We have made it a point each year to go to every church, take out all the radiators, clean them, and put on new bronze; I find that the aluminum bronze wears better than the nickel-plate. The people appreciated what we did as they were very much improved. This year we started to guarantee to keep them in repair for five years at our own expense.

MR. LITTLEHALES:—I have been very much interested in the paper read, and it is exactly in the line with my own experience. One thing I was very glad to hear taken up, and about which there has been a great deal of dispute; that is as to the desirability of separate meters for fuel gas. My contention and my firm belief is, (entirely apart from the question of making a special price for fuel gas) that if the price is the same for lighting and fuel, by all means have separate meters, for the very reason that Mr. Doherty assigns. I have seen many instances where it has cleared away difficulties and disputes. I had rather a funny experience in my own house. One night at about ten o'clock my wife went into the kitchen, and as she opened the door was overpowered with the sense of heat. The servant had gone to bed and left the oven of the gas range going at full tilt and it had been going that way since six o'clock and might have gone until seven o'clock the next morning had it not been discovered. How would it have been in an ordinary consumer's case at the end of the month if the charge for all the gas used in the house came on one bill? The servant would have protested that she had not used so much to cook with; the mistress would have known it was not used in lighting, and it would never have been discovered why so much had been consumed. That might have occurred two or three times a month; the gas burning all night, the mistress of the house knowing nothing about it, and the fault would have been laid on the gas company, as is the ordinary course. I believe that, even with equal prices for the gas supplied, two meters should always be used. It enables the consumer to see how economically the cooking can be done, it eliminates dispute, and the two bills look a great deal less than one.

Another point about the method of reaching consumers. I have had experience with a great many methods, and among them all I believe the canvasser is worth all the rest put together. I speak from my own experience. Each method has its value, of course, but if the canvasser does his work right, if he has covered the ground, he knows exactly the different people whom he has met, he understands their little peculiarities and difficulties, and when perhaps a consumer cannot see his way to pay for the range all at once, he can make the necessary arrangements for extending time for payments, which the advertisement in a paper cannot do, nor any other method which does not deal directly with the consumers.

The newspaper is not able to give the little accommodation, as the canvasser can do. I cannot speak too highly of the results of canvassing. I know also that great advantages can be gained by little exhibitions of cooking on the sidewalk; that sells hundreds of stoves; that has been my own experience; but canvassing is certainly the strongest. In my opinion if you can get the right man to do the work, you can be very successful in this way. In a little over two years in the introduction of gas ranges, by making special effort, we have been able to set upwards of 2,100 ranges. Those ranges are consuming 16,600 cubic feet each per annum, making 32,000,000 increase in fuel sales. That is certainly worth striving for and it can be duplicated in almost every case.

MR. GRAVES:—With regard to the gas range business there is one little matter in which I think I am in a position to criticise Gas Superintendents themselves. I have visited different companies, and have interviewed the different Superintendents, and I think that they are all very earnest in the use of gas for fuel; they advertise it and they talk it morning, noon and night. But I also find by personal investigation that at least fifty per cent. of the members of this Association do not use gas stoves up to the limit. What I mean by that is that they do not use gas stoves 365 days of the year. Why! there are some members of this Association who do not use gas ranges at all and I would not be afraid to wager that if a vote were taken here, it would show that fifty per cent. of the members of this Association have coal ranges in their kitchens. At the same time they are saying that gas is the economical and the right thing to use, and are trying to get everybody else to use it and to force coal ranges out and to put gas ranges in; but they do not use it themselves. They make all kinds of excuses themselves, but the excuses are practically valueless. Some of them make me think of the story about the man who was manufacturing a patent medicine. He was telling everybody what a good thing it was, and was expatiating upon its merits, when some one asked him, "Do you use it in your own family?" Said he, "Oh no! I *manufacture* it." People are very apt to think that if it is such a good thing in a house the Gas Superintendent ought to practice what he preaches.

There is one thing that I know a man who is in the gas business has accomplished in his own place, and the result has been very

satisfactory. I would advise you to carry out his plan of action and to go home and take that old coal range out of your kitchen and smash it up. Do not give it away; you do not want to give it to your friend because it might prevent your putting a gas range there. Then have your kitchen decorated; paint the wood-work white; get the nicest and handsomest paper there is to be found in your city or village and decorate the wall with it; give your wife money to go out and buy lace curtains for the kitchen; buy a carpet for the floor, and after you get all decorated, the carpet down, the lace curtains at the window, then get in a twenty-inch oven range; have a canopy made to cover it over and be sure that it covers the whole range; also be sure that you have it connected by a large flue to the chimney. Then what have you got? Why should not the kitchen be the handsomest and nicest part of the house? The average lady spends as much time in her kitchen as she does in the parlor. When you get the gas range in, and have put the coal range out, you can then have the kitchen just as pleasant and just as nicely decorated and keep it just as clean as you can any room in the house. And you can rely on one thing—that when you get that done and get your kitchen fixed up in that shape, every lady in the immediate vicinity will want to see it, and then she will want one just like it, because a good housekeeper almost invariably likes a nice kitchen. When your wife has thus got a twentieth century kitchen every other lady in that neighborhood will want the same thing and then you will have the satisfaction of practicing what you preach.

In connection with that matter I feel that I can make some suggestions which may be of interest and of value to gentlemen in the gas business, because as I am traveling through the country all the time I meet different people and I am always trying to observe what they say and then boil it down. I notice in a great many places that some of you do not seem to feel that it requires a good salesman to sell a gas range. You feel that almost any nice young man in your office can go from behind the desk when any one inquires about a gas range, throw the oven door open and tell about it, but he is generally anxious to get that customer out because he has a job to do on his books and besides he is not interested in selling gas ranges. His salary does not depend on how many ranges he sells per year; he has other work in connection with it. What I suggest is to put the brightest salesman you can

get in charge of your gas range business; tell him that you want him to make a record and that on that record depends his salary. Take an example from the coal stove men. What kind of a salesman do you want? You want a man who will sell good goods and who will sell what a man *ought* to have and not necessarily what he *wants*. I knew of a case when I was in the stove business, which will serve as an illustration of what I mean. A farmer came into the store with money to buy two stoves; he wanted a cook stove and he wanted a parlor stove. Well, a good salesman got hold of him. Every stove store has an A No. 1 stove that it wants to sell. This young man got hold of this farmer and his wife, and when he went out he left the store perfectly satisfied, but he had purchased but one stove; he had spent all his money for a range, and he went home perfectly satisfied because he had obtained a good range, and he let the parlor stove wait for another year. That is the kind of salesman you want. You want one who will sell your stoves and who will sell *good* stoves. It does not do any of you any good to sell a fourteen or sixteen-inch oven range. You want to take an example from what the coal stove men do. The coal stove men are the ones that you are fighting. When you put a gas stove into a kitchen you want to put one in which has just as much oven capacity as the average coal stove has—not with fourteen or sixteen-inch but with eighteen or twenty-inch ovens. Then when a lady gets the range into her kitchen, what is the result? She goes through the same motions of handling her baking in the gas range as she did in the coal range. There is no change in it. She moves right along without any trouble. There is no waiting for things to be done.

Those are facts in respect to which some of you may have had experience and will carry out. But I would like to say further that I find that some gas managers imagine that people who are selling vapor stoves and oil stoves are competitors of theirs, but they are not. They are the best friends you have. You can go all through the United States and you will find that where they used to do the biggest vapor stove business or where they used to do the best oil stove business is the very place for the introduction of gas stoves, for they have found out that an auxiliary cooking apparatus is very desirable, and when they have once used those they are more apt to take a gas range. The coal range man is the man you want to knock plumb in the head. He is the man you want to go for,

because what you want to work for is to induce people who use ranges three months in the year to use them twelve months. You want to get people to use gas ranges the whole year round. Then your output of gas will increase and all you gentlemen will have your salaries raised.

MR JENKINS:—I think when we have this parlor kitchen fixed up in the way my friend describes, we will naturally want people to see it, and we will be apt to invite our friends to the kitchen. Then when they come in there they will like the kitchen so well that they will stay there and the average superintendent would be swamped in a few days, as his salary would not go very far towards entertaining such a host of friends. I quite agree that a nice, clean kitchen and a good cooking stove (and with gas every time) is very desirable, but I think one of the most important things in introducing gas stoves is in allowing no one to set up that stove except yourself. The proper installation of a gas stove is everything, after you have got a good gas stove—and they are all pretty good by this time. I think that is one vital point in the introduction of gas stoves; we have simply refused to set gas stoves, to lease them or to sell them, unless we saw they were properly installed. We always do it cheaper than the plumber can and we know it is done a great deal better.

MR. PINKNEY:—I am a firm believer in the method of introducing cooking classes in the public schools. In Utica we have had a practical illustration of its benefit. Four years ago an enterprising and progressive superintendent of instruction in our schools succeeded an older man (very competent, however), and I was honored by a visit from him and learned that he designed introducing cooking into the schools, and he asked me during the interview what I thought of using gas. Of course, on that subject I had but one opinion. I suggested to him that the Gas Company would very gladly install twenty hot plates and a large range with oven for the use of the advanced schools. We did that and received from the Board of Education a vote of thanks Incidentally I received benefits from that, for my little girl, fourteen years of age, after attending the cooking school for two weeks, came home and expatiated on the benefits of cooking by gas; as we had a gas range in the kitchen I was very proud to eat a meal

which she had cooked on our gas range as a result of the lessons which she had taken in school on this subject.

I am a firm believer in that method of introducing gas. As to Brother Graves' suggestions, I believe if he was in the gas business and had the salary of the average gas superintendent as his only financial resource, he would hardly suggest such an elaborate lay-out in the kitchen as that.

THE PRESIDENT:—We would like to hear from Mr. Pratt on this subject.

MR. PRATT:—I feel that the subject has been so thoroughly covered that there is very little left for me to say. The only proposition suggested by the writer of the paper which strikes me forcibly is the second—"the general belief that it is more expensive than it really is." I think that is the idea that we must eradicate from the minds of our consumers and from the minds of our own people. It is the proposition that we have to contend with more than any other objection made. Of course, all these objections have to be met and answered when we endeavor to convince our consumers of the utility of using gas for cooking. In my experience there is no limit to this field. At the end of each year, although we feel that we have done a good work and are satisfied with ourselves, we realize more and more that the limit is not reached and that the field each year is greater than it was the year before.

I have myself come to the conclusion that it is not the man of means, the family of means, the rich man, that can afford to use a gas stove to the best advantage; I think it is the family with an income of $40 or $60 a month which can afford to use a gas stove better possibly than their richer neighbor can, and for the reason that the housewife in that case performs all the cooking of the family. It is not left to a servant, and consequently the results are much better; there is more economical management and we have no complaints from that clas of people.

We have used the prepayment meter with great success. It takes the place of the gasolene card that is hung in the window or on the porch, and, instead of the consumer spending fifty or seventy-five cents for five gallons of gasolene, the twenty-five cents or other amount that is dropped into the prepayment meter appeals to that class of people the same as the card does, and the operation of the

stove does not seem as expensive as would be the case if bills were presented for payment once a month.

Mr. Jenkins has touched upon a very important thought, and that is the importance of perfect installation of the stoves. I believe it would be economy for us and an advantage to us to be as active as possible in the better installation of the stoves. I am an advocate of the use of a canopy, whereby the odors and products of combustion may be carried away. In our practice we attend to the placing of every stove and follow up the setting of every stove by a visit from an instructor—a lady whom we employ, who is an expert in cooking, and thoroughly understands the use of gas stoves; she follows up each sale and each placing of a stove with instructions. That is done with every stove we set up, and upon that depends in large measure the small number of complaints received.

The seventh proposition of Mr. Doherty is the "dislike to abandon the use of a good coal, wood or gasolene stove." I suppose the principal objection to abandoning the old stove is because of the investment already made in it. It is difficult of course to get a gas stove introduced where this objection prevails unless the old stove is worn out. In many instances we have made exchanges for gasolene stoves. Where the purchaser has made an investment of twenty or twenty-five dollars in a gasolene stove we frequently make the exchange of a gas for a gasolene stove, even though we have to let them lie in our store room for future use or to sell to some one outside of our city. I believe in removing every obstacle that stands in the way of the use of gas for any purpose, whether by running street service, piping houses at cost, or selling fixtures at a very slight profit.

Mr. Harbison:—"Practice what you preach" is a very good motto for the gas man. As has been well suggested here, every gas manager, in my opinion, ought to use gas exclusively in his own residence for domestic purposes. In my own experience we have been doing that for the last three or four years, as there is not an opportunity to burn a pound of coal in my house. I heat the house with steam which is generated at the stable two hundred feet away and the steam is carried underground.

For all domestic purposes we use gas. The objection raised that the gas stove is not adapted to heating water readily is now over-

come, for there is an instantaneous heater made—I think in Chicago—and I have had one of them in my dressing room for more than two years. I have a bath-tub made to order for my own personal comfort; it is a little over size, but in from fifteen to eighteen minutes—never exceeding eighteen minutes—I have been able to raise the temperature of the water to 100 or 105 degrees, and that is hot enough for me to take a bath in. I am this week installing a second of those heaters in the butler's pantry in my house and another is now on the way from Chicago for the house of the President of the Gas Company, which he will put in his butler's pantry on my recommendation. They are a good thing and fill the bill perfectly. The first one that I installed cost me $36 in New York, but the one that is now being installed cost me about one-third of that amount and is made by the same parties. They will be glad to sell them, and at that rate every man can afford one of them who wants to heat water instantaneously. If you want a bath you can heat the water while you are preparing for the bath. That is a fact. I have tried it. I am giving you personal experiences, and that is the best kind of data to have. If the Association will come to Hartford next year, at its annual meeting, I shall be very glad to demonstrate to the satisfaction of every gentleman there the truth of my statements.

I do not at all disagree with the theory about having a nice kitchen. I think that if a gas man cannot afford to fit up his kitchen himself, the gas company he serves can very well afford to do it at their expense because of the good effect it will have on the gas consumers. With a gas range in the kitchen and gas appliances for the laundry work, there is no reason why the kitchen should not be kept as clean as the parlor. Your servant will have a lot of visitors—as they always do—they will observe it and they will be telling about it at their homes and they will require a nice gas range; it will prove a first-class advertisement which will pay the company a large interest on their investment in fitting up the manager's kitchen if he cannot afford to do it out of his salary; if he has not salary enough let him ask for an increase at the next annual gathering, for it is a good investment for any gas company to make I believe that cooking by gas is the way to do the business. We are at the present time installing gas in a cluster of flats and providing them with two 3-inch service pipes and two 2-inch

branches into each building, one at the front of the house, and at the rear for gas stove purposes. Those flats are being fitted up exclusively for the use of gas for domestic purposes and it is done at the expense of the owner of the buildings, arrangements being furnished by the owners of the buildings on my recommendation. Those are not exceptional cases. There will be about one hundred ranges set in Hartford in the year 1898, under just those conditions. I do not believe in small service pipes. I cannot quite agree with Mr. Jenkins that we must insist in putting in all the connections and installing all the stoves. We cannot carry that point out in practice with us because other people sell and introduce the stoves and ranges and we are glad to have them do so. We cannot compel purchasers to go to the gas company to have the connections made. The people who sell stoves are plumbers and they want to do that work themselves; it is their privilege and we do not interfere with them, but we are very particular to look after the work, see that it is well done and advise the plumber how to do it. That is as far as we have the right to go. There is no reason why every consumer in any district should not find it to his advantage to use gas for domestic purposes. It is the most economical and cleanly fuel that they can have. We must take pains to make that clear to them by using it ourselves. Have your own house fitted up for the use of gas and then see that every member of your Board of Directors has his kitchen fitted up in the same way, so that whenever he talks gas he may be able to say that he is practicing what he preaches. Suggest it to your stockholders and advise them that it is for their own interest to burn gas so as to increase the dividends. That is an important item which is not to be lost sight of. I think this is the most important part of our industry.

Mr. Neal:—In all this discussion and in the paper which has been read, my case has not been met. I am a gas consumer, but only for a portion of the year. If I were to paint my kitchen white, or even paint it red, and carpet it, provide a collation and invite my friends to come into my kitchen and see my gas range work when the temperature was as low as it was here yesterday in and about this hotel, instead of inducing my friends to stay for a while they would all leave at once, because my kitchen would be cold. My heating apparatus is on a level with the kitchen and I

have no steam; therefore the gas range will not heat my kitchen. What shall I do in that case? I have got to take part of the money which I save by the use of a gas range and spend it in some way for heating my kitchen.

MR. A. E. FORSTALL:—Mr. Doherty speaks of an instantaneous water heater under pressure. I do not know that I have the heater of which he speaks, but I have had either that or its first cousin in use in my house for the summer and I have been in a position to receive the plain, unbiased, unprejudiced opinion of the women of the household, as to the merits of that heater. I am sorry to say that from their standpoint the heater is not a distinct success; I was afraid to try to put it in anywhere else. In the first place, it would not supply hot water fast enough; it is all right for the bath, but if you want to wash dishes it is slow. A servant does not want to stand and wait ten minutes to get hot water enough to wash the dishes in. That is the first objection. Then on wash days they could not get hot water enough without lighting the separate burner, and when that is lit the gas bills increase at a wonderful rate. From my point of view the disadvantage is, that no matter at how low a temperature you want the water, the half-inch coil prevents its being drawn very fast unless you have a very high pressure on the street main. At my house the pressure is usually forty pounds and at times will run up to eighty or one hundred pounds; even then it sometimes takes quite a long time to get water enough heated for a bath. Another objection that I have to it is that every time it is turned on, every light in the house jumps. I have a ten-light meter to furnish gas for the stove and for this heater, and an entirely separate pipe taken directly off the service. The service is only one inch in diameter but I do not think that an inch and a quarter service of the ordinary length in our town would give any better results. I have it on a separate meter and so can tell the amount of gas it consumes. In our family there is a baby and a couple of small children and we want hot water all the time. There is absolutely no restriction to the use of the hot water and I suppose we use more than the average family. The average consumption of gas is about 100 cubic feet per day. But I am going to take the heater out. I have not dared recommend it to any one for the reasons given - the women did not like it and it does make the gas jump.

THE PRESIDENT:—We have had quite a discussion of the gas stove business, and before it is wound up I will give my experience. I advised our company to invest something like $16,000 in the buying of 1,000 stoves, intended to be loaned out. We loaned them out, and the people entered into a contract with us to return the stoves in ordinarily good condition. The idea was that they should not use less than 1,000 feet per month. We have found that the consumption averages a little over 1,800 feet per month. We concluded to let them run on for a while before we invested more money, and see what the result would be. We wrote off every year 25 per cent. so that at the end of four years the cost of those stoves was written off to the profit and loss account. Whatever stoves have come back to us have come back in very good condition. The repairs we have had to make have been very small. We find that they are constantly sought after; before I left home the man said that he had applications for 160 stoves, and asked what he should do. I said, "Have you no stoves which have been returned?" He said that he had no stoves which had been returned that he could loan again. I asked him how many stoves we had lost, and he said that he had had an inventory made, and that we had lost but one stove during the three years we had been loaning them. We figure up the interest on the investment; we figure up the cost of the stoves; we figure up everything connected with the stoves, and we find by doing that we were able to take these stoves, put them in, let the people use them for a while, and return them in good condition, and still make a large profit on the sales of gas. Our people authorized me to buy 2,000 additional stoves and put them out in the same way. So far we have found that is the way we have been best able to introduce gas stoves.

MR. GRAVES:—I think your plan is just about the same as the Rochester plan, and I can give you some figures which may not be exactly correct, but are approximately so. The Rochester people have pursued that plan for three years. They now have out on contracts between four and five thousand gas ranges. Those ranges are put out under a contract in which the Company insists that the user of the stove shall consume at least 500 feet of gas per month, or pay fifty cents per month. Gas is selling there at $1.00 per thousand. Now, whenever a person comes in to sign one of those contracts they send them one of the old ranges,

not a new one. They have ranges which have gone out and come back for some reason, and it is those ranges that they send to the users of the stoves.

THE PRESIDENT:—That is the way we do.

MR. GRAVES:—I have known of people coming in there and asking, "Are you going to send us up a new range?" The reply is, "Well, we cannot tell. If we have one which has been used, we will send that, but practically it is just as good, because we take the range apart and clean it up before we send it out." The great advantage the Rochester people claim for it is that they give people just what they ought to have. They do not give anything less than an 18-inch oven, and they connect the range with a ¾-inch pipe. If anybody wants to have their own people connect them up, they are very willing they should do it, but will not allow them to connect them up with less than that size of pipe.

THE PRESIDENT:—Our experience was so satisfactory that we intend to continue the plan. The only expense we have to day with the ranges is that of re-tinning the drip pan. Those things give out, and we have to re-tin them at a cost of six cents apiece.

MR. GRAVES:—I will say that the Rochester people told me that the average expense of keeping the ranges in repair was ten cents a range per year.

THE PRESIDENT:—Ours would be more than that.

MR. GRAVES:—That is just what their expense figured up to. I will say further that if any member of the Association would like to see the contract under which the Rochester people put out their ranges I will be very glad to show it to them.

THE PRESIDENT:—Does Mr. Doherty desire to say anything in reply?

MR. DOHERTY:—I would like to ask Mr. Searle the population of the city where 30,000 ranges were put out.

MR. SEARLE:—I have in mind one city which put out 12,000, and I think that was Kansas City.

MR. DOHERTY:—How long did it take to put those out?

MR. SEARLE:—I think they were put out in about 16 or 18 months.

MR. ROPER:—In about eight months.

MR. DOHERTY:—What is the population of the town?

MR. GEORGE CLARKE:—About 200,000.

MR. DOHERTY:—And 12,000 ranges were put out in eight months? Was it done by the free installation plan, or by advertising and soliciting?

MR. GEORGE CLARKE:—By free installation, but, of course, there was lots of soliciting done.

MR. DOHERTY:—Probably you advertised and solicited more actively than any other gas company in the United States.

MR. GEORGE CLARKE:—Undoubtedly we did.

MR. DOHERTY:—What was the price of gas?

MR. CLARKE:—Fifty cents.

MR. DOHERTY:—I do not believe Kansas City should be taken as an illustration.

MR. SEARLE:—I have heard that in Boston they put out 20,000, but I understand they have abandoned it now.

MR. DOHERTY:—I simply want to make this point—that I do not believe in giving away stoves as a means of inducing people to use them. I think it is more talk than anything else that creates the demand for them. From my own experience, I may say that in Madison, Wisconsin, I could have given away stoves very readily, and probably my judgment would have lead me to do so. In the first place, we do not put in any free services. We charge for services more than they cost We charge for stoves two or three dollars more than they cost. I have put out there in the last two years one gas stove for every twenty-five inhabitants. We never lost but one stove. All these things are to be considered. Here is a town of 17,000 inhabitants, and a very large section of that town we cannot reach. At this time we do not have six miles of main larger than two inches. We put out one gas stove for every fifty inhabitants. We have secured our business by advertising and soliciting. I do not think the time is ripe for free installation. We are spending 25 per cent. of the money received in hiring solicitors. I intend to see that the men we employ as solicitors make big salaries next year. We want only men who

can do effective work. We are going to command the best service to be had. Now, in regard to water-heaters, Mr. Searle says that a heater which has an efficiency of only 75 per cent. is too expensive for use. Mr. Doty says that he has a heater arranged with a thermostat, which is satisfactory in its economical working. Now, if that thermostat controls the gas, does not shut it off entirely, but simply controls the rate of flow, I have an idea that his heater is of very low efficiency, and I am surprised that he has such good results from it. I can hardly conceive of a water-heater with a thermostat which simply controls the rate of flow being efficient. It is just the same as in a boiler plant. Your efficiency falls off when your grate service is not working to the highest capacity.

Mr. Pratt says that he would remove all objections to the use of gas. To do that you would have to give away the gas. If you charge for services (and I think most people will pay for services) then you have merely got that much more money to do something else with. Your plant costs that much less. You are that much better off and eventually you can make gas cheaper. I do not say that it is unwise to put in free services, but I do think it is often possible to be "way ahead" financially and that we may often do a much larger business eventually by not giving free services too soon. There is another thing I want to refer to. I notice that a great many gas men come up here and say that they *believe* the use of gas is best in the kitchen. Now, I would "fire" a man out of my place who would say "believe." He would have to be positive about it.

In regard to cooking schools I want to say that for the past three seasons our company has had in its employ a graduate of the Boston Cooking School. When I first took charge of the Madison plant we wanted to get the co-operation of some of the ladies there and did it by organizing some cooking schools, and succeeded in organizing what is the largest organization in the city of Madison—The Housekeeper League—and we have not only established three cooking schools but the city was induced to put cooking in as part of the instruction in the common schools. We hired the demonstrator, furnished the room, furnished the gas and gave the public school children above ten years of age lessons in cooking and also gave free lectures to the public. I kept track of this enterprise very carefully and am able to trace the results obtained. Of course cooking in the public schools reaches just the

class that we want to reach. That is, it reaches all classes, whereas the free cooking lecture does not. I think many of you will find the same thing that we did, that the same people attend the performance and that they are the people who already have gas stoves, or else are people who live where they cannot get gas. To make it more effective we borrow a consumer's kitchen and then let the neighbors know that Mrs. So and So is about to give a demonstration there.

Mr. Searle spoke about giving away gas stoves to replace a gasolene stove which stood in the way. If you give away a gas stove and they still retain the gasolene stove, they are very apt to use it, whereas if you make an exchange you would get the gasolene stove away from them. We have two hundred gasolene stoves stored in an old barn, and we can sell these out in the country or take them to some other gas man's town and sell them cheap.

There are some things in this paper which I hoped would provoke discussion. They were written for that purpose. I am sorry the discussion did not come out. I have said here, or in another place, that there are some complaints which cannot be cured. I have about come to the conclusion now that every complaint can be cured, and for the last two or three weeks I have held our complaint-man accountable for every complaint, and no matter how crazy or cranky the people were, it was his business to cure that complaint. He *must* do it. Every complaint which cannot be cured must eventually come to my desk and I see to it that the complainants get satisfaction. I think there is no complaint that we cannot satisfy.

As to hot plates, I do not believe that they are the fore-runners of gas stoves. I would rather sell gas stoves outright than try to sell people hot plates with the view of introducing gas stoves. They will stand in the way of placing a gas range, and people will buy them if they can buy them conveniently. We do not handle hot plates at all. If people come in and ask for them, we do not at first know what they are. If we have to sell them, we do it. I think we have sold them this year to two saloons, but even there we insist upon selling ranges just for the appearance of it. It is simply a matter of talking to people. You can sell them almost anything you want to.

Mr. Doty said, on the garbage question, that with a coal range you had your ashes, tin cans, etc. to get rid of: that kind of re-

fuse is not objectionable, but it is matter subject to decomposition which causes trouble and which can be burned in your coal stove, but cannot be gotten rid of with the gas stove. Ashes, and things of that sort, you can pile in your back yard for a year, for there is no offensive material in it, and the Health Officer will not get after you It will not prove obnoxious to the nostrils, although it may be to the sight. As to the matter of getting rid of garbage, that is rather a more serious question, and I know it is troublesome to the people who have gas stoves, where there is no provision for getting rid of it.

In the matter of selling gas stoves on the installment plan, I think that is the wisest thing to do, and that it is the easiest way of disposing of them. You know how ready people are to buy something if they can only pay for it at the rate of a dollar per month. That is human nature. We must take advantage of that desire on the part of the public; it is just as pleasant, if they can find some way of buying, as to have a thing given to them. The novelty of having a thing given to them wears off eventually.

Mr. Littlehales made the statement that soliciting was worth more than all other methods of acquiring business. I agree with him thoroughly as to that; but you have got to advertise and demonstrate and pave the way for your solicitors. We pay our solicitors on the commission basis. We do not get discouraged if, when our man goes around, people will not let him in; we do not give that fellow up; that is not a bad case, for the next time the solicitor goes around there is no telling what he may accomplish.

Just before I came here I took my Kodak out and took pictures of a dozen houses in the town where we had put gas stoves in, and particularly in one locality I took a dozen pictures of the worst tumble-down old huts you ever saw; nine of those had paid for their stoves and the others will pay for them; all of them are paying their gas bills promptly. When we first put out those stoves they were used in the summer time only; but now many of them use them the year through, and we have placed stoves in lots of houses of three rooms only—in fact they are nothing more than little huts.

Mr. Doty spoke about advertising from a central point. That certainly seems desirable to me. It takes lots of time and work to write suitable advertising matter; if we do write out our own

advertisements and figure up the time we put into it, it becomes an expensive thing. He spoke of some New York house which sends out cuts and advertising matter, and it is probably the same house that wrote to me. I would not like to criticize it, for they would be apt to retort that I did not know what good advertising methods were. But we all know the reasons why gas is not used (where it is not), and we ought to know better what to say about it than those people. I think I know what to say in my own town. Again, this advertising service is quite expensive. They charge $2.75 per week, for a cut and a little reading matter that any of us ought to be able to supply and the charge is more than it is really worth. I am in favor of any scheme which will give us suitable advertising matter without our own individual attention, but in this case I think they charge too much.

On motion of Mr. Neal, the thanks of the Association were voted to Mr. Doherty for his paper.

THE PRESIDENT:—The next paper will be read by Dr. E. G. Love, on "The Loss of Illuminating Power of 25 to 30 Candle Gas when Mixed with Air"

(For paper see Appendix, page liii).

MR. WHEELER:—Dr. Love's paper is on a very interesting subject; I think the experiments he has pursued are within the reach of all of us I can hardly agree with him in the statement that a mixture containing only five per cent. of air is hard to detect. I think those of us who are gas men can quite readily detect the presence of five per cent. of air.

In the field of 24 candle-power water gas, I have personally made a number of experiments at different times, using as a diluent, air, carbon dioxide and a heavy furnace gas. I have always found that a mixture of as much as five per cent. of air has reduced the gas 13 or 14 per cent. in candle-power. This gas was half-and-half coal and water gas Quite recently I had some experiments made upon a water gas which was 22.9 candles. The experiments were made very accurately by our Long Branch Superintendent, Mr. Tuttle, and his results show that five per cent. of air added to this 22.9 candle gas reduced the candle-power to 19.9 candles or 13.1 per cent.; ten per cent. of air added to this gas reduced the candle-power to 15.7 candles, or 31.4 per cent. In each case

THE BEAL MEDAL.

NOTE.—This Medal was later awarded to Mr. DOHERTY for his paper.

every precaution was used and all necessary corrections made for temperature, barometer, etc.

The amount of air which can be admitted with safety during the process of oxide purification is a point which bears directly upon the candle-power, and I think it can be safely said that beyond 2½ per cent. of air as a maximum limit we cannot go with safety, as the candle-power begins to drop in a marked degree, and requires more oil added in the carburetter to offset the loss due to the admission at the purifiers. It is probably true that 1½ per cent. is the practice of most gas engineers in admitting air at the boxes. With this quantity some engineers claim that there is no extra oil required, and even that there is a slight gain in luminosity; others claim that even with this small amount a small percentage of oil has to be added to keep the gas at the required candle-power.

The subject of Dr. Love's paper, "The Loss of Illuminating Power of 25 to 30 Candle Gas when Mixed with Air," is a very interesting one for a variety of reasons. Considerable experimentation has been made, not only in the ordinary way of mixing air with an enriched gas in certain proportions, and then measuring the candle-power with the photometer, but also in the way of measuring the luminosity of the same in a Bunsen burner; these latter experiments are perhaps more interesting than the ordinary one of measuring the loss of candle-power due to small proportions of air mixed with the gas.

There is a line of experiments in the matter of testing the luminosity of gas in the Bunsen burner which I think are very interesting. They are certainly very important in the matter of manufacturing gas stoves and Welsbach lights.

Prof. Lewes, at the 1897 meeting of the Incorporated Gas Institute, read a most interesting paper upon the theory of the atmospheric burner. In this paper he made experiments upon the amount of air, of nitrogen and of carbon dioxide required to render a 16.3 candle-power coal gas non-luminous when consumed in a Bunsen flame. He found that one volume of gas required 2.27 volumes of air, 2.30 of nitrogen, or 1.26 of carbon dioxide, respectively, to render the flame completely non-luminous. In a 43 candle-power gas it required 7.86 volumes of air, 4.71 volumes of nitrogen and 3.12 volumes of carbon dioxide, respectively, to

render this richer gas non-luminous. These figures, he says, reveal the interesting fact that with a rich gas far less nitrogen than air is required to bring about loss of luminosity on account of the high temperature produced by the combustion of the heavy hydrocarbon with the oxygen in the air. In this series of experiments, he says, that while it required 5.38 volumes of air to render a 24 candle-power gas completely non-luminous, it required but 2.27 volumes of air to render a 17 candle coal gas non-luminous.

He also shows the difference in temperature between blue and green non-luminous combustion, and shows that green combustion requires 3.37 volumes of air. The theory of these mixtures and varying temperatures resulting therefrom is very important indeed in the manufacture of scientifically constructed gas burners for stoves, and has a most important bearing upon the whole question of fuel gas. The experiments of Prof. Lewes to which I have referred are classical in their thoroughness and beauty, and his paper should be on the desk of every manufacturer of gas stoves as well as upon that of every gas man.

THE PRESIDENT:—Cannot Mr. Miller give us some information on this subject?

MR. A. S. MILLER:—To me these experiments appear conclusive and do not leave anything to criticize. It is a great pleasure to have this subject cleared up, for there has been so much wild guessing and so many loose statements made on the subject that I began to feel that none of us knew exactly where we were. I was very glad indeed when Dr. Love agreed to do this work. I am under very great obligation to him personally for clearing the subject up as he has. There is nothing further to say. The experiments are conclusive in themselves.

MR. DOHERTY:—I would like to ask Dr. Love a question with regard to the photographs: whether they were taken under exactly the same conditions, with the camera at the same distance from the flame, the same time of exposure given, and with the same diaphragm. Were the conditions just the same?

DR. LOVE:—Identically the same.

MR. SEARLE:—I would like to ask Dr. Love if in any of those photometric observations it was possible to have had the camera so designed that the lens could have been subdivided by a dividing engine to get the flame area on the photograph.

DR. LOVE:—Yes, it would have been possible, but would have involved an amount of labor for which I had not the time.

MR. A. C. HUMPHREYS:—In the spring of 1882, I gave considerable attention to the mixing of air with rich oil gas and to determining the effect upon the candle-power. While I have not the figures with me I have the general results in my mind, namely, that the figures that had been previously published were absolutely misleading if they were taken as results for general adoption, and without regard especially to the candle-power of gas. It took but very little work to demonstrate that with a rich oil gas a considerable percentage of air could be introduced, and the candle-power of the gas would be increased as far as any practical results were concerned. I think that is one of the chief points which is to be borne in mind in this connection. We must have clearly in mind, in the first place, what the candle-power of the gas is, before we can determine what is going to be the result on the gas of mixing it with air. A great deal of instruction can be derived from experiments of this kind applicable to the general subject of photometry. We only have to make a few experiments in this direction to determine that we have nothing like absolute candle-power to guide us. I could, for instance, take an ordinary burner and burn a large quantity of oil gas, altogether too large for that particular burner to use, and the result of course would be a very low efficiency. I could put in forty per cent. of air, and by carefully arranging a burner that would burn that gas to advantage, I could get a better result after the addition of that forty per cent. of air than I could without any air. I mention these facts to show that the subject cannot be treated in any general way; but practically, Dr. Love has covered the subject for us in our ordinary business, because he has shown what the effect is of air on gas as we ordinarily use it. I would suggest however, that very likely the difference in effects shown between water gas and coal gas is due in great measure to the difference in *candle-power* between those two gases.

MR. LITTLEHALES:—I would ask Dr. Love if the relative areas of those photographs would indicate the relative illuminating power; or, is a portion of that due to the actinic power of the flame. Would the relative sizes of those white portions indicate the relative illuminating powers in the different photographs?

DR. LOVE:—I have a very little to say in reply. In answering Mr. Littlehales' question I would merely state, as I tried to in the paper, that the photographs give actual sizes so far as they can be reproduced by photography. The actinic rays are the only ones which affect the photographic plate, and for this reason the dull yellow rays which are found in the upper portion of the blue zone, being weak in actinism, make this part of the flame, as shown in the photographs, somewhat larger than it really is. The actual flame does not show any sharp line between the luminous and non-luminous portions. The camera was so placed that the image on the ground glass was of the exact size of the flame, and no change was made in the positions of the burner and camera until all the photographs had been taken.

It was thought that it might be a matter of interest to place side by side the photographs of flames obtained from different mixtures of gas and air.

As to the statement made by Mr. Wheeler, that five per cent. of air could be detected in the flame, I may say that I placed burners at the two ends of my photometer. In one of these unadulterated gas was burned, while a mixture of gas with five per cent. of air was burned in the other, the consumption being five cubic feet in each case. I may not be a very good judge, but at the distance from the photometer table at which both flames were visible at the same time I was unable to detect any difference, and I was looking for one too. Had the flames been in close juxtaposition it is very probable that a difference would have been noticed, but in this case a comparison flame was used, and my statement referred to the detection of the presence of five per cent. of air without such aid. So far as I could see the flame looked like a rich water gas, without any of the impoverished appearance which is very noticeable when the quantity of air exceeds 8 or 10 per cent.

The subject is one of great interest and many of the points which the work suggested had greater attractions for me personally than the particular question which I was endeavoring to answer. It is a subject regarding which, as Mr. Humphreys says, we know comparatively little. You may adapt your mixture to certain conditions, and your burner to certain mixtures. but these are not the conditions in ordinary practice. Under such circumstances it becomes a matter of scientific investigation.

MR. LITTLEHALES:—Would it not have been a fair test in the admixture, for the sake of argument to assume that you put in twenty-five per cent. of air, and made the test with a four-foot burner, and would it not have been a fairer test to have tested it with the five-foot burner? Of course when you mix air with it you necessarily have a lesser quantity of gas. Would it not have been a fairer test to have increased the size of the burner so as to give the same quantity of gas burned as you had before?

DR. LOVE:—I will answer that question by asking Mr. Littlehales: Would you have done that in the case of a consumer?

MR. LITTLEHALES:—No.

DR. LOVE:—I judged it from the consumer's standpoint. With a five-foot burner you would oblige your consumer to increase his consumption of gas.

MR. LITTLEHALES:—I was looking at it only from the standpoint of its deterioration.

DR. LOVE:—There is no doubt about that; if you want to burn such a mixture to the best advantage you must change your burners—you must change the conditions—but the moment you introduce any new element it destroys materially the value of the test.

MR. A. E. FORSTALL:—The difference between Dr. Love and Mr Wheeler may be but another illustration of the silver and gold shield. Is it not possible that the composition of the two gases experimented with, the one by Dr. Love, and the other by Mr. Wheeler, might make a difference in the visible influence of a five per cent. mixture so that both may be right.

DR. LOVE:—I think it is very probable. I experimented with a twenty-six candle water gas, and my conclusions were based upon gas of that quality, and not upon a mixture of water gas and coal gas. I referred in my paper to the importance of knowing more relative to the effect of incombustible diluents upon the constituents of the gas, and introduced the extract from Dr. Frankland's work as representing about all that had been done in this direction. We know something of the effect of air upon an illuminating gas as a whole, but we know almost nothing of its effect upon the individual constituents, especially those which give luminosity to the flame.

I did not catch Mr. Wheeler's figures when he spoke of a loss of thirteen per cent.—I think that is what he said. What was the percentage of air which produced that loss?

MR. WHEELER:—Five per cent. That was with a mixture of half-and-half, coal and water gas.

DR. LOVE:—What was the candle-power?

MR. WHEELER:—Twenty-four.

DR. LOVE:—I was working with a straight water gas which was practically two candles higher. You will see by the table of results which I obtained that 5.4 per cent. of air in the mixture caused a loss of 11.24 per cent. in illuminating power, or a little over two per cent. for each per cent. of air. Mr. Wheeler's results show a loss of 2.6 per cent. for each per cent. of air in a five per cent. mixture, which, considering the greater deleterious effect of air on coal gas than on water gas, accords very well, I think, with the figures which I obtained. Presumably the higher the candle-power the more air will the gas stand. I think this has been abundantly proven by the experiments which have been made.

MR. A. S. MILLER:—I move a hearty vote of thanks to Dr. Love for his kindness in presenting this paper to us.

(Carried.)

THE SECRETARY:—I think there is hardly time for another paper before the recess, so I will read one or two questions from the question box:

"Why not make the Union on three-light meters the same as on five-light, so they will be interchangeable?"

MR. LITTLEHALES:—In my view of that question it would be one of the best things we could do. It would be a great convenience.

MR. A. S. MILLER:—If there are any meter makers present we would like to hear from them. I do not suppose there is a meter user in the room who would not like to see that done. Probably it would be just a question of a small increase in cost; but it may be that there is some practical objection to it. If so we would like to hear from the meter makers.

MR. MCILHENNY:—I do not think there is any objection to doing that if the gas fraternity wants it done. I do not think it

would cost any more. There is a large number of three-light meters out. The proportion of threes to fives is about as ten to one. Of late there are more fives going out than there used to be; but a great many companies issue three lights. It would make some confusion in making the connections. We would have to replace the meter with another, we would have to turn off your gas, and of course the greatest trouble would be with the gas people. The meter makers would not object. I do not see why they should. The slight difference in cost between the three-light and the five-light screws would not count for anything in the matter. The trouble would be with the gas people themselves. They would have to pay for the connection, and for the lead pipes, the soldering in new caps, etc. Of course that would be a serious matter. Besides, I do not see why a five-light screw would be any better than a three-light when it comes to the practical working of the meter. This screw as it is, is amply large enough to pass all the gas that the meter will measure. I do not see what would be gained by putting a five-light screw on a three-light meter, supposing that the three-light meter is quite large enough for the use to which it is put. But I see no objection to putting them on if a company wants them.

MR. HARBISON:—I think a better answer to that question would be to discontinue the manufacturing and the use of three-light meters. I claim that a three-light meter is not large enough for our wants at the present time. It is not sufficient to pass gas enough to light an apartment and heat it, as is frequeutly done by a radiator on the same meter. In Hartford we do not intend to ever buy another three-light meter. We are using up those we have on hand for small consumers, and shall use them as long as they last, but we are not purchasing anything less than five-light meters. I think if gas engineers will consider the future they will not send in many orders for three-light meters from this time on. The supply is wholly insufficient where they use gas stoves and do not have separate meters; it is wholly an insufficient supply for the stove and the light at the same time.

MR. BOARDMAN:—I think Mr. Harbison's views are very correct for a large company that is able to pay for meters, and to buy five-light meters altogether. But some of us small fry have to be content with three-light meters. We go into small estab-

lishments, a barber shop for instance, or an office, and put in two, three or four burners as the case may be. We are very glad to be able to get that far. We cannot very well afford to put in a five-light meter. We have got a lot of three-light meters on hand, and I have taken out three-light meters in many instances where gas stoves were used, and have put in five-light meters. Now we do not want to go to work and buy another five light meter to put in there, but would like an opportunity to put in a three-light meter, and that will answer their purpose just as well at present; when they have used gas for a while, and finding that the bill is not so enormous, and that the meter is not altogether unreliable, they will perhaps want to put in a little stove and do some heating, and gradually they may work up to the need of a five-light meter, and then we can put in the five-light meter, and use that three-light meter in another place. It is on that line I think that the question is asked, to enable the smaller gas companies who have to use three-light meters with their small consumers, to put in a three-light meter, and then take it out and substitute a five-light meter, when there is occasion for it, without additional cost. I think it would be a good idea to recommend to meter manufacturers hereafter to make their three-light meters with five-light connections, unless otherwise instructed, so that that can be done without any extra expense. Quite a number of the smaller companies are perfectly willing, whenever they can afford to put in five-light meters, to make the change; but they would rather have the original connections made so that one can be substituted for the other. Sometimes it works the other way. Rather than take out a five-light meter they would let the five-light meter stay in a place where electricity was used; they cannot get rent for the meter, and it does not pay to put in so much capital. I think it is a very good suggestion to the meter makers to have it understood that unless otherwise instructed they should put in an interchangeable coupling.

MR. CATHELS:—I would call attention to the fact that some of our friends have very large ideas. Of course our friend Harbison represents a very large company, but there are some here like myself, who represent small companies, and we do not like to spend a lot of money in buying larger meters. The three-light meter is only three-lights nominally. A three-light meter will very satisfactorily deliver gas to seven or eight ordinary burners. I con-

sider from three to eight ordinary burners going constantly a very good consumption of gas. In most houses from three to five lights is the ordinary number going at one time. The three-light meter fully answers the purpose in such cases. Of course the use of a stove may necessitate another meter; but I think that the three-light meter is for ordinary household use of ample size. Of course I would like to be able to put in five-light meters, but I must say that as far as the couplings go it would be advantageous to have couplings for both the three and the five-light size. It might save a great deal of bother and trouble. But I would not advocate the disuse of three-light meters.

THE SECRETARY:—I have some written answers to this question:

"It would certainly be a great convenience, and I favor it very much."—*Northrop Moore.*

"I say, Amen, to this question."—*J. W. Gwinn.*

"It would make trouble in small works from mistakes in setting a three-light where a five-light was barely sufficient. Why not abolish the three-light meter?"—*M. Bowes.*

MR. A. E. FORSTALL:—As far as I am concerned I may say that I think the three-light meter is useful in many places where a five-light meter is not needed. There is a difference in cost between a three-light and a five-light meter, and most of us have some meters that are not paying. What would be the use of putting in five-light meters when we cannot make the three-light meters pay us?

MR. LITTLEHALES:—The tendency at the present time is to require smaller size meters. The great number of Welsbachs put in reduces the consumption per burner enormously, and a three light meter that was barely sufficient when we were using five or six flat flame burners, is abundant when you are using a Welsbach, because there is only one-half the consumption of gas.

THE SECRETARY:—I have another question:

"What is the best method of separating the oil vapors from water gas, without the use of water? If water has to be used, what is the effect on the candle-power?"

MR. LITTLEHALES:—Is there any other way of separating?

THE SECRETARY:—I think that question was intended for Mr. Miller.

MR. MILLER:—The Committee on Research has that as a standing subject, and hopes that some member will very kindly enlighten them on it.

MR. EGNER:—I think that putting water gas through a condenser would do it.

MR. MILLER:—I would like to state that I have spent a great deal of time and money in investigating that subject, and I have tried to persuade some of the other members to do the same thing. I tried the ordinary scrubber, made up with wood strips one inch square, placed one inch apart, built so as to break joints. The gas was taken beyond the relief holder after it has been through the ordinary scrubbers and condensers, and cooled to eighty degrees. This scrubber would take out a portion of the tar, but not all. The P. & A. condenser was tried. The gas was put through that at all rates of speed, from barely flowing through a six-inch condenser up to flowing beyond its rated capacity. I do not know exactly what its rated capacity was, but I weighted the float so as to run it under very considerable pressure. That did not remove all the tar. Then one or two special scrubbers were designed by my assistants and by one of the members of the Association, Mr. Rusby, of Jersey City, but they did not seem to be much better. Finally I sifted down to shavings. I simply filled a pipe full of shavings, and passed the gas through that, and all the tar was scrubbed out. I have just ordered six scrubbers, ten feet in diameter, each one to have twenty-four vertical feet of shavings in it. I think that system is in use at Omaha, and Mr. Knapp tells me that it is working very satisfactorily. In connection with that work I made a great many tests of candle-power to see about how much candle power was being lost in these various scrubbers. The gas was about twenty-seven or twenty-eight candles. I did not make any test of the loss of candle-power in the first scrubber because it did not remove the tar, but I tested the P. & A. scrubbers, to see to what extent it did injure the gas. I found that the gas lost about two per cent. of the illuminating power in the P. & A. scrubbers, and about the same in the shavings. It lost about the same in the purifying boxes. So that we did not lose any more in the scrubbers than we did in the boxes. I did not however make

any test of the gas that had been scrubbed through the shavings' scrubber, and again after it had been scrubbed through the purifying process. In other words I might lose two per cent. in the shavings' scrubber and then again lose two per cent. in the purifying boxes. I will test that some day when I get the new plant in. At the present we have made connections so that all of the gas goes through the first box in each set of purifying boxes, and that box is filled full of shavings. We first filled it in the ordinary manner, as we would with oxide, and found that while there was scarcely any back pressure it did not take the tar very long to get through the shavings. Reducing it to figures, the tar would begin to show on top of the purifying boxes when something like three thousand or four thousand cubic feet of gas had passed per bushel of shavings The box was then decked over solid about midway between the top and bottom leaving an opening opposite the inlet, so that the gas had to travel horizontally through the bed of shavings, and then rise through the opening. A second deck at the top of the box compelled the gas to travel horizontally through the upper layer of shavings. This arrangement increased the efficiency from three thousand to four thousand cubic feet of gas per bushel of shavings up to thirty-five thousand to forty-thousand feet. When we get the new scrubbers we hope to do better than that, and if the Association is interested in the matter I can probably tell them more about it next year.

MR. SOMERVILLE:—I would like to ask Mr. Miller if he took the temperature of the gas at the P. & A. condenser. Of course if the temperature is high the tarry matter will get into the scrubbers; but if the gas is cool the P. & A. scrubber will take out the tar There is no doubt about that. I think it is largely a question of temperature. It seems to me that when those shavings get saturated with tar they would be no longer able to absorb the tar. What is done then? Are the shavings taken out and renewed?

MR. MILLER: —I think I stated that the gas came out of the regular condenser at about eighty degrees. The gas in the P. & A. was tested between seventy-five and eighty degrees.

As to the amount of scrubbing that the shavings would do, I think I stated that we could get a duty of between thirty-five thousand and forty thousand cubic feet per bushel of shavings;

after which it was necessary to change them. The scrubbers which are being built at this time were designed with a view to removing the shavings at a nominal cost, and also to loading them at nominal cost.

MR. EGNER:—Mr. Miller has told us that the illuminating power was reduced two per cent. when using the P. & A. condenser; but he has not stated how much it was reduced after passing through the shavings.

MR. MILLER:—It was about the same in the shavings as in the P. & A.

MR. EGNER:—I used shavings fourteen years ago with water gas and got about the same results as Mr. Miller did, except that I used the shavings in the lower tray of the purifiers. They were very effective. I put a layer of shavings on trays below the purifying material, and we got from thirty-five thousand to forty thousand feet.

MR. KNAPP:—Mr. Miller has referred to the scrubbing of gas at Omaha through shavings.

We put in just before the purifiers at our Jones Street Works, a scrubber 8 feet 6 inches in diameter and 22 feet high, designed to to be filled with slats, and water to be introduced at the top for scrubbing in the usual way.

This was some five years ago. The reason a scrubber was put in at this point was to catch the small amount of tar that reached our purifying boxes, and which had been caught by a layer of shavings at the lowest box tray, and by omitting the shavings and one of the lower trays we got an increased depth of oxide and so increased our purifying capacity.

It seemed to me wrong to use water for scrubbing cold gas, and I asked permission to try instead dry scrubbing with shavings. What we call shavings are really planer chips. Instead of the slats and water I used two layers of planer chips, on old purifier trays cut to fit the scrubber shell 8 feet 6 inches in diameter and supported by cross bars of Tee iron.

The first time I tried this method I used dry chips, some 30 inches thick for each layer, and in a couple of days I had so much back pressure in this scrubber, I had to take out the planer chips, and found their absorption of moisture had swelled and packed

the chips so tight as to cause a stoppage of the proper flow of gas. It is necessary to wet the chips to be used for this purpose a day or so before putting them in place, so they will be thoroughly soaked and swelled up, and it is a good thing to screen them over a common mason's sand screen to take out the very fine stuff.

After I got over these difficulties and found 16 to 18 inches to be about the right thickness for a layer of chips, or 75 to 85 bushels to the layer, I changed the chips in from ten days to two weeks, and this gave 40,000 to 50,000 feet of gas per bushel of shavings.

As no tar showed through the lower layer of chips, and no discoloration through the top layer in this length of time, I gradually increased the time between changes. I ran over six months before making the last change and we put through something over 100,000,000 cubic feet of gas and no tar showed at the purifying boxes, although the two layers of chips were discolored all the way through. This is a duty of some 580,000 feet of gas, scrubbed per bushel of chips. The usual back pressure from this dry scrubber was from one to two inches.

Sometimes more back pressure showed, and I got clear of this by turning the exhaust steam from the exhauster engine into the gas at the outlet of the exhauster: this warmed up the chips in the scrubber and always reduced the back pressure to the normal in an hour or so.

In regard to the loss of candle-power by such dry scrubbing, I do not remember the exact figures, but I made three readings per day, bringing the gas from each side of the layers of chips and continued the test for a week, and repeated the test at another time, and when I came to sum up the results the candle-power was the same on each side of the layers within one per cent. I concluded there was no practical loss of candle-power in this method of dry scrubbing.

I have had a scheme in mind for some time for scrubbing or separating tar and entrained matter from illuminating gas by a centrifugal discharge wheel.

We now have an exhauster to draw gas from the relief holder and push it through the purifiers and station meter to the storage holder. I believe if we substitute for the exhauster, as commonly used, this centrifugal discharge wheel, something like the blast

wheel of a common blower, but on a vertical shaft in preference to a horizontal shaft, and enclose the same in a suitable casing for the purpose, we would have a perfect tar separator as well as a good exhauster all in one. In this way we would not add to the apparatus necessary for operating a gas works, or to the cost of installing or operating the same, but would increase the efficiency of the apparatus already necessary, and I believe we would get the last particle of tar and entrained matter from the gas and send it to the purifiers perfectly cleaned.

The Association then adjourned to meet Thursday, October 20th, at 10 A. M.

SECOND DAY—MORNING SESSION, OCTOBER 20, 1898.

The Association met at 10 A. M.

THE PRESIDENT:—The first paper we will take up this morning will be that by Mr. J. M. Rusby, on the "Depth of Fire in a Water Gas Set."

(For paper see Appendix page xxxi.)

THE PRESIDENT:—This paper is now open for discussion, and we would like to hear from Mr. Norris on this subject.

MR. NORRIS:—In considering the question of "Deep *versus* Shallow Fires," it may be well to state briefly the general action of a water gas generator, and the ends for which we are striving.

The object of the blasting is to store heat in the fire for the subsequent decomposition of steam, such storage of heat being effected by raising the temperature of the fuel bed. It is evident that for the consumption of a unit weight of carbon during the blow, the heat absorbed by the fire is the difference between the calorific value of carbon, say 14,500 heat units, and the sum of the heat carried off as sensible heat by the escaping products of combustion, and as potential heat, in the shape of corbonic oxide. Anything that tends to reduce these last two items, tends towards fuel economy.

I assume that we have plenty of heat for the subsequent fixing of the oil, and that we are trying to store as large a proportion as possible of the heat of the carbon in the fuel body. With a

given blast pressure the shallower the fuel bed the smaller the per cent. of carbonic oxide, and this makes for fuel economy. But, on the other hand, the shallow fuel bed does not allow time for the hot products to impart their heat to the fuel, and so the escaping products are hotter than with the deeper fire. And this makes for high fuel consumption. In other words, if we reduce the depth of the fuel we gain on the one hand, but we lose on the other; these two things tend to counterbalance each other.

In Mr. Rusby's experiments it appears that the net fuel consumed per thousand is not affected very largely by the change in depth of the fuel bed. The two actions seemed to about counterbalance each other, the net fuel consumed being about the same with both depths of fire. But there was a marked advantage with the deeper fire, in greater capacity of set per hour, and in reduced boiler fuel, due to the deeper fire decomposing a greater per cent. of the steam supplied to it.

I spoke of the amount of heat stored in the fire being affected by the percentage of carbonic acid in the escaping products. It seems that the depth of the fuel bed has less effect on this than the question of the temperature of the fire. Mr. Rusby's analyses show that in the blast gas the carbonic acid was at the beginning of the blow as high as eighteen per cent. and at the end of the blow it would drop to seven or ten per cent. and that not only were the products at the end of the blow going off at a higher temperature, but they were going off very much richer in carbonic oxide. If we could cut off the last minute of the blow we would apparently increase the proportion of heat stored in the fuel bed; but we really cannot do that because the high percentage of carbonic acid at the beginning of the blow is due to the low temperature of the fire, and if we attempt to reduce our final temperature we reduce the range within which we can run, and so reduce the amount of steam decomposed.

Quite a favorite prescription to save fuel, is to cut off the last of the blow. But it is difficult to do that, because in shortening the blow we really are shortening at both ends. It is like the man with the potato patch who complained that the potato bugs ate up all the outside rows. He was told that the remedy was easy enough: "Don't plant any outside rows; plant all inside." We cannot do away with a last minute of blasting.

As a matter perhaps of some general interest, and to get it on the record, I have here quite a number of analyses of blast gases, where the circumstances were entirely different from those of Mr. Rusby. The blast pressure under the grate was only four inches; consequently the "fuel bed head" was very low.

These analyses will give some idea of the minute to minute variation. The C O was not determined in each case, but it is practically a function of the amount of C O_2. The figures in any one vertical column were of samples collected during the same blow.

PER CENT. OF C O_2 GENERATOR BLAST GAS.

6 FT. GENERATOR.

2d minute	11.0	12.6	10.6	18.0	13.6	18.2	15.1	16.4
3d "		11.0	9.0	13.6				
4th "	6.8							
7th "	6 4	4.8	5.0		7.6	9.2	7.2	8.0

In the case of the last four samples in the above table the C O was determined with the following result:

PER CENT. OF C O IN BLAST GAS.

2d minute	6.5	0.0	5.4	3.2
7th "	18.6	14.6	20.0	17.2

Mr. Rusby states that the percentage of acid in the gas decreases with the deeper fire: that is, there is a further decomposition of the carbonic acid as it passes up through the upper layers of the fire. This is rather a disputed point. It will be remembered that *The Journal of Gas Lighting, etc.*, published some years ago a table giving the results of some experiments by Dr. Bunte.

This table showed that for a certain temperature of the fire there is a certain proportion of carbonic acid formed which seems to be independent of the depth of the fire. I assume that he means that in the presence of excess of steam the incandescent carbon seizes the steam rather than the carbonic acid, and increases the bulk of the gas produced rather than reduces the carbonic acid in the gas. This has been confirmed by some experiments made in analyzing water gas as produced in a Hanlon Leadley W Set, with three fires, where the steam passes down through two fires, to the bottom of the third and then up. The analyses showed that the per cent. of carbonic acid at the top of the third fire was practically the same as at the bottom. In other words passing through this third fire did not reduce the percentage of carbonic acid present.

THE PRESIDENT:—Will Mr. Miller give us his views?

MR. MILLER:—I had some experiments made in the same line in order to see to what extent my results would check with those of Mr. Rusby's. In running a water gas set there is an almost infinite number of conditions affecting the results, such as the blast pressure, the amount of steam, the depth of the fire, and all the other various circumstances that enter in. The result is that it was only by a long series of tests that we could arrive at any approximate conclusions, and those that we did arrive at were only approximate. I found however that the results which Mr. Rusby has given were very closely borne out in our experiments. I tried to account for them by assuming that all of the work was done in the fire within three feet of the grate. Making this assumption, and assuming also that all of the coal that was thrown in above that was merely used there to catch the heat which would otherwise be wasted from the fire, we found that that coal would save just about the heat which Mr. Rusby claimed to save. In other words, there was about one and a-half to two pounds of carbon, or the equivalent heat of a pound and a-half or two pounds of carbon which was stored in the coal above the three feet in order to bring it to the temperature of the fire, assuming the fire to be 1,800 degrees.

There is a very interesting point brought out by Mr. Rusby in the fact that when he disregarded the conditions of the carburetter and super-heater, and ran his fire at a very low temperature, there

was an enormous reduction in the amount of coal consumed. This matter was very forcibly brought to my attention some time ago when I was called upon to check up the actual operation of independent cupolas as compared with the double super-heater apparatus. We found that the independent cupolas could be operated with from three to five pounds less per thousand cubic feet of finished gas than the double super-heater apparatus. At first I thought there was something radically wrong in the operation of the double super-heater apparatus, and I spent a great deal of time myself, and I put experts to sit up with the independent cupolas to see if we could not get some points from them. But taking the different apparatus and figuring it out I found that it was not so much a question of the depth of the fire (in which I am somewhat irrelevant in my remarks), as it was a question of the radiation from the shells and the temperature of the fire. In other words, running the fire at as low a temperature as possible, consistent with converting the steam into water gas is very much more economical than running the fire at a high temperature and allowing the water gas to leave the fire at a high temperature. I have not figured it over to see whether the sensible heat of the blast gases and the water gas on leaving the generator fire was enough to account for this difference; but that difference, and the difference in the percentage of carbonic oxide in the blast gases in the two cases must of course account for the difference in economy.

It is a fact that there is a very considerable difference in the coal, when a fire is operated at a low temperature, from what there is when it is operated at a high temperature. It is of course necessary to operate it at a comparatively high temperature when you have to use the escaping products to heat the carburetter and super-heater. I have not been able to make any tests with the fire over seven feet deep to get at its economy, but, as Mr. Rusby suggests, there would be an enormous excess of fuel needed to force the blast through, and it is probable, if there were any saving, which is doubtful, this saving would be more than counteracted by the extra boiler fuel required to run the engine.

Mr. A. C. Humphreys:—Will not Mr. Miller explain what he means by the independent cupola?

Mr. Miller:—I mean a generator that is used alone, and not

in connection with a carburetter or super-heater. In other words, a generator from which the blast gas goes out into the air, and is wasted.

MR. NORRIS:—Mr. Rusby spoke of the enormous increase of boiler fuel that would be required in blasting a deep fire as compared with a shallow fire. The actual boiler fuel required in blasting, estimating a water consumption of forty pounds per indicated horse-power, figures out to about two and one-half pounds per 1,000 cubic feet of carburetter gas made. So that if you use twenty per cent. more horse-power in blasting a deep fire, there would be an increase of only about one-half pound of boiler fuel per thousand feet of gas made; which is not very serious.

MR. EGNER:—The question which is before us has been very fully solved by a German by the name of Dellwick. I do not know that the process has been patented in this country, but he gets the useful effects of a shallow fire and of a deep fire at the same time by admitting air into the generator at different heights above the grate. In this way he is able to make short blasts, and to save fuel, and at the same time get the heat necessary to decompose the steam in the upper part of the generator I mention that as worthy the attention of users of water gas apparatus. It is a simple thing to do. I made some experiments in that line years ago, and from my experiments I have no doubt that Dellwick is correct. I would like to make a suggestion to the younger members of the profession who are making water gas, and that is, to try and design an arrangement by which the water gas apparatus could be managed automatically by clock-work and electricity.

The thing can be done. For example in the Fire Department of New York City, the alarm comes in and is recorded on a little ticker, and the same current loosens the horses in the stalls, sounds the alarm on a large gong, disconnects the engine boiler from the stationary portion in the cellar, and lights the fire in some cases. I think some of the members here might set their inventive minds to work in that line and do something really beneficial to themselves and to the gas industry in general. The thing is possible and practicable.

MR. GLASGOW:—Replying to Mr. Egner's reference to the Dellwick process, I wish to say that I have been unable to discover that Mr. Dellwick's ideas are in advance of common knowl-

edge in water gas operations in this country. I may speak somewhat positively in this connection because of the recent attention I have given the matter.

MR. EGNER:—I think this Association owes me a vote of thanks for bringing Mr. Glasgow to his feet and inducing him to tell us something about that process, of which we all know by reading about it. But I do not want to withdraw my remarks about the utility of putting in air in that way.

MR. GLASGOW:—I will explain in a few words what the Dellwick process is. The latest application for German Letters Patent contains but a single claim, in words something like these: "I have invented and claim as new, a method of producing gas, consisting in so adjusting the depth of generator fuel and the strength of blast that the products of combustion issuing from the generator during the blast shall contain more carbonic acid than carbonic oxide." You may draw your own conclusions as to the invention originally involved. The introduction of air for such a purpose at different zones of the fuel is described in patents fifty years old.

MR. SEARLE:—I have recently spent about five months on the operating floor, and had a very interesting experience in the use of gas coke and different depths of generator fire. I found it an advantage to run a fire between three and four feet deep with very high blast pressure in the endeavor to accomplish what Mr. Dellwick claims is new, which however was nothing more or less than the same effect suggested by Mr. C. R. Collins, in a paper before this Association, that is to blast very hard and burn a large part of carbonic oxide in the fire bed, thus raising the temperature of the fire and economizing fuel.

Comparing gas house coke and anthracite coal at different fire depths, we want to remember that in blasting an anthracite coal fire we are certainly burning the coal to almost perfect combustion in part of the fire. When we bring the air through the fire we have a surface contact with the coal, the carbon is burned from the surface and the coal is then coated with a film of ash, and we have exposed to the steam when making a run incandescent ash and incandescent carbon. Now about increasing the depth of the fire with anthracite coal, we have a greater depth of

carbon to decompose the water. It is desirable, if it were possible, to blast very hard at the end of a blow, in order if possible to dislodge some of this ash with which the coal is coated, thus bringing a larger surface in contact with the steam, giving a higher fuel efficiency both in generator and boiler.

MR. A. E. FORSTALL:—I have a short written discussion on this paper by Mr. Francis Carroll, of New Orleans. He writes:

"I have made many analyses of the blue gas from our generators, and invariably found, if they were clean, with a thirty-six inch bed of fuel, as good a gas, and as much, as with a six foot bed. The same results exactly from a generator furnace in coal gas benches, with fuel bed reduced from three feet six inches to one foot six inches. But there was too much danger in working the low fuel bed. In testing the blue gas, quantity and quality was taken on each one. The old Springer, in Chicago, with a three foot bed of fuel gave good gas. But I do not know of its economy in working."

Now, on my own account, and following out Mr. Miller's parallel between the separate generator and the combined generator, carburetter and super-heater, I must say that the separate method has always appealed to my lazy side. It has seemed to me from my experience that it was a great deal easier to set the outside fire to work to fix your oil than it was to depend upon your carburetter and super-heater; that it took a great deal less watching, and I have always been anxious for some one to fix up a scheme by which it could be done as cheaply as the other way, even if I had to give up the advantage of extra manufacturing capacity.

I am sorry to hear what Mr. Glasgow says about the Dellwick process, because I had rather built my hopes on that. It always seemed to me that there was a geat deal less danger from loss by sensible heat escaping, than there was from allowing the unconsumed carbon to escape; that is, you had to increase the sensible heat so much before you would get the requisite number of heat units, in comparison with the latent heat lost in the unconsumed carbon, that it appeared to me that it was better to let the sensible heat go than it was to let your carbon go, and if by saving the carbon you increased the sensible heat, that did not make very much difference.

I rather built my hopes on the Dellwick process for getting up a superior generator apparatus, and I thought that was on a line that would pay for investigation. If some one was so situated that he could get the weight of the escaping gases from the separate generator, and figure out the exact amount of heat that was carried out in the sensible heat, and at the same time figure the latent heat in the carbon which is wasted in the ordinary process of blasting, and compare the two, we could see right where we stood, and we could then determine whether it was worth while to consume the heat in blasting the carbon, rather than putting in extra fuel to do the work of gasifying the oil.

MR. SEARLE:—I spent about a year in separate generator work, and I can tell Mr. Forstall that it is not the lazy side of the business; it requires about ten times the attention that a double superheater does, and is nowhere near as efficient for super-heater purposes, nor as economical. There is no basis of comparison. It certainly makes cheap gas and good gas, but instead of appealing to the lazy side of a man, it will put gray hairs into any man's head who undertakes to run it properly.

MR. EGNER:—Mr. Carroll has mentioned the apparatus which he saw in Chicago. I designed that apparatus. I went to Chicago in 1883, and at the Division Street Works of the Peoples Gas Co. was shown a huge empty shell, and was told to go ahead and do what I could with it. I had to arrange the apparatus to suit the inside of the shell. The problem was to make the grate of a suitable arch, build a skeleton arch over it, and allow for space in that in which to put a sufficient number of fire brick to fix the gas with other necessary details. Our fuel bed was about three feet deep, and as near as I can remember, we used about twenty-six to twenty-eight pounds of coke per thousand, and the oil was about four and one-fourth to four and one-half gallons per thousand feet of gas. The candle-power of the gas was measured by a jet photometer, and so I do not want to quote it. The jet photometer made it twenty to twenty-six candles. I am rather inclined to think it was not so high as that. That apparatus worked well for about four years or more. It was a good apparatus, and I believe that it was the largest water gas apparatus ever built and operated in the world. The inside diameter was fifteen feet nine inches. The low fuel bed seemed to work very well.

I wish to say, in reply to what Mr. Glasgow has said about the Dellwick specification, that that may be interpreted in another way. Mr. Dellwick wanted to impress the German engineers with the idea that he was not wasting any fuel. Before I go any further I want to say that I do not know Mr. Dellwick, have never seen him, and whatever conclusions I have come to have been derived from reading his descriptions.

He knew that the German engineers considered that the ordinary water gas apparatus wasted a great deal of fuel in the shape of carbonide oxide which was burned in the super-heater and largely heated beyond the requirements, and he wanted to impress on them that in his apparatus the carbonic acid predominated and that there was no such waste. That was his idea. Any gentleman having a water gas apparatus can easily apply the air blast at different levels, and I think they will be benefited by the experiment. It would be worth while for some of you to try this and let us know the result.

MR. A. E. FORSTALL:—Before Mr. Rusby replies I want to call attention to the element of personal equation in all the results we get. Mr. Searle has worked both processes, both the separate generator and the combined. I have also worked both processes, and I hope that we are both reliable, and yet we arrive at totally different conclusions. I acknowledge that my combined process was a rather inferior apparatus, but three years working with that combined process, and seven years with the separate process, in my case led to exactly opposite conclusions to those stated by Mr. Searle. We must bear in mind in all discussions, that we have got to take everything on the basis of the speaker's or writer's personal equation, and make proper allowances.

MR. RUSBY:—As Mr. Norris has pointed out, the shortening of the blow and run effects both ends of these periods, but nevertheless this process can be made to lower the average temperature of the fuel bed, and as long as the lowest temperature does not fall below the point necessary for the decomposition of steam, the fire becomes more and more efficient in absorbing heat during blow, and giving it out during run to make water gas.

Concerning the Dellwick process, I would call attention to a point in some printed reports upon it. The inventor claims great

improvement over the fuel results obtained in ordinary European practice in the making of water gas. He quotes as such common practice, however, the use of a blasting period which is very long compared with that adopted in the operation of his own apparatus. I think that whatever improved fuel result he obtained is due most largely to the shortening of the blasting period.

I believe that Mr. Searle is using gas house coke as his fuel. I would suggest that coke is a much poorer conductor of heat, because of its porosity, than is anthracite coal. If, therefore, an anthracite coal fire and a coke fire be blasted for the same length of time, the surface temperature of the coke will become much the hotter, and since it is this temperature which determines the production of carbonic oxide, this latter will be produced in much greater quantity with the coke than with the anthracite fire. To offset this tendency a *very* short blow must be resorted to with the coke fire. This means less heat stored and consequently a shorter run. When the run becomes too short for convenience in operating the apparatus, the only other resort is to make the fire somewhat shallower as Mr. Searle has done.

As Mr. Egner and others point out, and as my paper states, increased depth of fuel bed gives somewhat increased liability to production of oxide. Admitting that a certain amount of heat must be carried over to the fixing vessels, either in the form of sensible heat or carbonic oxide, for their heating, then, as long as this quantity be not exceeded, the deeper the fire, the greater will be its steadiness and capacity for making water gas.

Mr. Searle:—I will say with regard to my practice that that is the conclusion I arrived at, and that we had now gotten down to selecting a period from the blows and runs formerly operated under, which gives us the best conditions and excellent results. We have a very inferior gas house coke which the men call "feathers," and during the five-minute blow we used to operate under, we had more carbonic oxide than we could dispose of. We have selected a depth of fire which is best suited to our conditions and blast as well, and when we operate under two-minute blows and five-minute runs, and when we have arrived at just the point with the heats in the super-heater that we want, we then quit and make a run, and so regulate the depth of fire to

obtain this result. As to the use of a separate generator and separate bench practice, I would say that it is the thing which would drive a man crazy.

After many attempts with oil retort practice you will find it is impossible to obtain oil efficiency which is possible to obtain with a double super-heater apparatus.

MR. MILLER:—Referring to a subject which Mr. Forstall introduced, but which is not exactly germane to the paper, I would suggest that Mr. Forstall worked this apparatus seven years ago, as he says, at which time the conditions of operating, and the skill in operating that apparatus, were very different from what they are now.

On motion of Mr. A. C. Humphreys, the thanks of the Association were voted to Mr. Rusby for his paper.

THE PRESIDENT:—The next paper will be read by Mr. Walton Forstall, on "Notes on Mains and Main Laying."

(For paper see Appendix page i).

(The Vice-President, Mr. A. C. Humphreys, takes the Chair).

THE CHAIRMAN:—Mr. Forstall has ably discussed a most important subject. I venture to suggest that so far in the United States it is a subject which has not received the attention it deserves, and especially the systematic oversight of street work. It is well worthy of very careful consideration. Will Mr. Shattuck open the discussion?

MR. SHATTUCK:—As to weights of pipe, I prefer the Philadelphia to the Society of Gas Lighting Standard in the case of four inches and six inches, on account of greater thickness insuring better hold for service ells and greater transverse strength. In case of the larger sizes, twenty inches, twenty-four inches and thirty inches, I think the New York standard ample.

In the methods of connecting services or new mains to existing mains, I differ with the method described by the writer, in that I object to split sleeves, service sleeves and saddle-pieces. My objections are the difficulty of controlling the gas during the operation of putting on sleeves, and the enlarged joint area after the service is connected. If bags are used why not cut in branch and be assured of a better job.

My method for connecting small sizes is suggested in the following table:

Size of Service.	SIZE OF MAIN.						
Inch.	16 in.	12 in.	8 in.	6 in.	4 in.	3 in.	
	Hole in.	Hole in.	Hole in.	Hole in.	Hole in.	Hole in.	
1¼					1¼ If heavy pipe	2 ¾ holes ¾x1¼x¾ Tee	
1½					1¼	See 2 in.	
2					4x4 Tee, 4 in. Nipple 4x2 R. C. Cement j'nt in Tee	4x4 Tee 4x3 Red 4 in. N'ple 4x2 R.C. (4x1½ R. C. for 1½ Service)	
2½				6x4 Tee or 6x6 Tee & Bushing, then 4 in. Nipple and R. C. as above	Ditto. 4x2½ R. C.	Ditto. 4x2½R.C.	
3		3	8x4 Tee or 8x6 Tee and then similar to above.	Ditto 4x3 R. C.	Ditto. 4x3 R. C.	Ditto. 4x3 R.C.	
4	16x4 Tee or 16x6 Tee and Reducer	12x4 Tee or 12x6 Tee and Reducer	8x4 Tee	6x4 Tee	4x4 Tee	4x4 Tee	

Size.	MAINS.						
4	4 in. Nipple	4 in. Nipple	4 in. Nipple				

In laying mains I believe it pays to seek for new methods. Experiments often pay for themselves very soon. I used a derrick on a twenty-four inch main this season, which I believe far superior to the old fashioned three-legged or four-legged derrick. I have seen a four-legged derrick moved seven times in laying one pipe, where this derrick would have done the same work in its original position and in the time ordinarily consumed in raising and lowering the pipe once.

It consists of a traveler on a supported beam to which is attached a Yale Town Triplex Hoist. One man can raise or lower a twenty-four inch pipe. The derrick is also provided with rollers on the base of the legs and requires very little lifting. It can be easily

taken apart and loaded on a single wagon. The weight of the derrick complete is 750 pounds. It is designed to handle 3,000 pounds. It cost $100. It has been suggested to make this derrick of angle iron. I have a picture of it here which may be interesting.

It is quite obvious that eccentric specials are superior to concentric ones. In laying all branches a piece of pipe of a full

length put in the outlet insures facility for extensions and preserves a future right of way. The bushing is preferable to the plug with a hub cast on.

As to records, I may say that I had the advantage of learning the system of records described by Mr. Forstall, as his assistant, and have since employed it. It is as easily used in rough country roads as in the city. The unit in roads I have taken as 1,000 feet, taking perpendicular measurements from street property lines and running measurements from dividing property lines, using a county map for an index map, and running in obscure property lines with transit. The beauty of the system is that any engineer can learn how to find all of your main information in ten minutes, or in other words, some one else can read your notes besides yourself. Granted that the system of inspection and records under discussion increases the cost of laying pipe, the saving in future facility in the handling of office records, unnecessary cutting of pavement, and looking for specials or joints not accurately located, would more than make up for the increased cost. I have made it a practice to locate a joint nearest each fifty foot station, and all cut pieces beside the specials. I think the specifications attached to this paper are very thorough, and require few changes for local conditions.

Mr. Littlehales:—This question of main laying is probably one of the most important subjects brought before this Association. I think there are few of us who realize as fully as we ought the difficulty in making thoroughly tight joints. I have had very strange experience in testing some pipes, and I find that the fire test is scarcely worth wasting time with, so far as getting tight joints is concerned. I have found further, that even when testing every joint most carefully and thoroughly with soap-suds and finding no leak, there was nevertheless a considerable leakage from the main. The question arises whether part of that leakage may not arise because of the porosity of the metal itself, known as exosmose, which is a difficult matter to get at. I think our greatest troubles in leaking mains is due in great part to a desire for cheap work, and too much pushing to get the work through. I think it is almost impossible, or at least unreasonable to hope for good results in main laying when the work is rushed. I have seen some pretty good specimens of it at different times, and the

trouble to correct it is so great, and the expense so great, that it behooves us to get the very best work we can to start with. Cost should be a secondary consideration.

I would like to ask Mr. Forstall whether from his own tests or from any information he possesses he has given us any figures as to what is the lowest rate of leakage per mile of main he has ever known.

It is desirable to get some sort of standard which can be considered as the standard of excellence. For instance, so many feet per mile per day, or per annum, as the case may be. Then we would know where we were at.

One feature which I want to emphasize is the utter uselessness, from my standpoint the worse than uselessness—the utterly misleading character of figuring leakage on a percentage. I have in mind two instances from actual records: one is of a company whose leakage is four and three-fourth per cent.; its actual leakage is 1,490 feet per mile per day. Another has a leakage of twelve per cent. and it is 700 feet per mile per day. The percentage of the one is three times that of the other, although the leakage is in fact only about one-half. I have a number of other cases in mind showing even much worse than this. You can find those discrepancies right straight along.

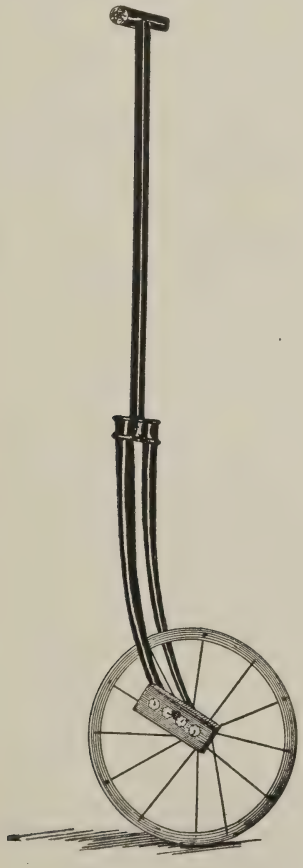
I am sorry that Mr. Forstall. in dealing with this most important question did not give some figures on that point. If we could get some sort of standard as to what should be considered first-class conditions as to the leakage per mile of main, it would enable us in our work on main laying to see whether we are reaching the standard of excellence.

The system which Mr. Forstall shows of connecting up mains is, I think a very excellent one. My friend Mr. Cathels, of Hamilton, Ontario, has a very nice arrangement for plugging off his mains when making extensions which he will probably call to your attention. It is by the use of a series of rubber rings, re-enforced by plugs, which can be pulled along like a ramrod in a gun barrel. It is very effective, and will be found very useful in extensions or mains.

In this specification there is, as it seems to me, one serious omission, for there is no provision in the way of work let by contract, for the removal of ashes, or for substituting soil in place of

ashes, where you run into a piece of made-up ground. In my experience there is nothing more destructive to mains or services connected with them, than getting into ashes. They make the cast iron just as though it had the small pox; it will pit it all over.

In Europe it is the practice almost invariably, when contracts are let for laying mains, to put in an express stipulation that wherever ashes are met with in trenches they must be entirely removed, and the contractor must get clean soil to take its place. To me that is rather a serious omission in that specification, which otherwise I consider most excellent.



In the method of recording, there is no fault to be found. It is all that is desired.

I would ask Mr. Forstall whether from his experience he can give us any idea what should be the standard of work, that is, how much per mile should be considered standard work in our main laying?

In connection with this subject of main laying, I will call your attention to something which any of you can make up at a very low cost, for use in measuring. If you want to send a man out to measure the length of a main, or to measure a main when down, he can take this along with him. It is a home-made article. Most of you will recognize the shape. The wheel is from a child's little express wagon. To get it of the right diameter I soldered on two bits of tin with a lap of leather between them, and I have used an old discarded twenty-light meter index, geared in such a way that as the shaft turns with the wheel the

ten point pinion on it gears into the first wheel of index, so that as the wheel turns around it indicates one yard for every revolution. It is very convenient if you send a man to the other end of the city to ascertain how much main will have to be laid, or to measure up work when completed. There is no question about his counting his steps right; he simply takes this in his hand, goes ahead with it, and this contrivance does the rest. The bicycle arm connected with the wheel cost me a dollar, the wheel cost fifty cents, and the whole thing, including the labor, cost me $3.75.

MR. CLARKE:—Is there a patent on it?

MR. LITTLEHALES:—No. Any of you can make it.

MR. CLARKE:—What is the matter with using a bicycle?

MR. LITTLEHALES:—The bicycle cyclometer is geared to miles, and we do not often go into such very long stretches. This shows in yards, and a man can take this in his hand, or on a street car without any inconvenience.

MR. WITHERBY:—I have one with yards on it.

MR. LITTLEHALES:—Then it is so much the better for that purpose.

(The President resumes the Chair).

THE PRESIDENT:—I think Mr. Jenkins has something to say on the subject of this paper.

MR. JENKINS:—In his paper Mr. Forstall has so thoroughly gone over the ground that it leaves very little room for discussion. Since receiving the paper I have not had much time to read it over; but there are one or two points in it that I think it well to call attention to.

On the first page he says, that "one and one-fourth inch is the smallest service run, and all services to four inches inclusive are wrought iron." I do not believe in going over three inches with wrought iron services. I think that we can better afford to put in four inch mains of cast iron, on account of the better quality of four inch cast iron mains.

On the next page he says, "a one and one-half in. service would be connected to a three inch or four inch main by a split sleeve tapped for a one and one-half inch or two inch hole respectively."

I think it much better to put the sleeve on at once, and give the full opening that you want for your service right at the main. And the same thing in tapping a two and one-half inch service for a six inch main with a two inch opening. I would prefer by all means to have a two and one-half inch opening, and you can get it just as well as not.

It think a very important point has been touched upon on page five. Mr. Forstall says, "Outside of the necessity for greater vigilance in order to obtain tight joints where contracts are let, there is the serious disadvantage, especially in large cities of the indifference to the comfort of the public, that is so often characteristic of contractors."

I do not believe we can be too careful in just this very matter. It is bad enough to have to tear up the streets in our large cities, but if we do interfere with traffic it behooves us to put to just as little inconvenience as possible the persons living along the line, and those who have to use the street for the time being. I think we should lay ample stress upon this matter. I fear that too few of us attempt to do so. The majority will let the public take care of itself as best it can, letting them climb over our ditches while we go on with our work. As much as possible we want to escape complaints from people who are dissatisfied with our work, and who want to get rid of us.

I have found also that the offset pieces do come in very handily every once in a while. In laying a twenty-inch main this summer we came to a point where we had to go under a thirty-six inch water pipe, and a little further along had to go over a twenty-four inch pipe. They were very close together, but the use of two twenty-inch offsets allowed us to bridge one pipe, and go over the twenty-four inch pipe. The offsets came in extremely handy.

THE PRESIDENT:—Will not Mr. Rusby make a few remarks?

MR. RUSBY:—At our place we have just been laying some mains by contract, and to provide against the danger of having bad joints or else of having a great deal of trouble in compelling the contractor to make good ones, we did the pipe laying ourselves.

On page eleven Mr. Forstall states that in cutting out the head of this thirty-six inch plug he was first compelled to remove a twelve-inch plug in the bushing, and he says that he took that out

before doing any other work. That is rather an interesting detail, and I would like to inquire just how it was done.

In the specification for laying mains there is specified the use, as supports, of two blocks for each length of pipe, one near the bell and one near the other end. I have always rather objected to generally allowing anything of that kind under pipe, because it is apt to be relied upon to do the supporting, and it may not be competent to do it. The bearing surface of these blocks is comparatively small. I would like to know if that is the general practice?

MR. MILLER:—There is a reference here to the standard sizes of mains of the Society of Gas Lighting. A reference to the report on those standards would show that they were simply weights suggested, and it was qualified by the statement that every man should decide his own weights according to local conditions. There was no rule laid down, but every man was expected to decide for himself.

On page six Mr. Forstall says that, "where long lines of large pipe are to be laid, and work has been begun at the cheapest end, it is interesting to watch the keen endeavor to keep down the increase in cost that naturally comes as more expensive conditions are encountered." That "endeavor," can very easily be overdone and the work suffer in consequence.

On page eleven he says, "its working (bell) end was closed by a plate of wrought iron clamped on a rubber gasket upon the face of the bell." As rubber is soluble in gas, I should say that this was very bad practice. An asbestos gasket should be used, and would be practically indestructible.

These specifications are very elaborate, and very fine from the point of view of the gas company. But we must understand in making contracts that the contractor is not going into the thing for the sake of his health. He is expecting to make a fair amount of profit. If we go into the contract with the idea of allowing him to make a fair amount of profit we are likely to get the work done most satisfactorily and cheapest. When we throw on him an enormous increase of burdens, or the risk of a great number of burdens which he cannot foresee, that contractor, if he be a responsible one, and of the class of men that we want to work for us, is going to put on a price to cover all contingencies. A close

examination of these specifications shows that there is an enormous number of contingencies to be figured on, and it results in figuring to a large extent blindly, until the contractor has reached a point where he can know the soil thoroughly. If there is a ring of contractors in town the company is practically at the mercy of that ring, until some outside contractors are able to come in and know the town, by which time they will probably be on specially good terms with the other contractors, and will join the ring. It seems to me specifications can be very much better drawn to cover conditions just as we find them, and allow a reasonable amount for any extra work. What I would consider as extra work would be the changing of a main due to some unforeseen condition. In other words, specify a certain reasonable number of test holes, and lay out the line of main accordingly. Then if it becomes necessary, through circumstances entirely unforeseen, to change the line of the main, let the company pay for them. Also, if questions arise, give the contractor a fair chance for his rights. According to this specification the contractor is to go there and to do exactly as he is told to do, and have practically no recourse.

I think that the result of working under these specifications will be that the work will cost the company a great deal more money than it would under other specifications, and especially will this be true if it is a new company. As a matter of fact I think that has been borne out in practice, that the company for which these specifications were written has paid a very large price for its work originally, and that as the contractors got to know the company, and to know the conditions, each year they knocked off a certain amount until they got down to the point about where the company could have done the work itself.

Mr. J. J. Humphreys: — Experience has pretty thoroughly convinced us that the use of the pressure gauge is not a good method of testing recently laid mains in long lines of twenty-four inch mains. We have had an experience which convinced us that the only way to test them was with soap bubbles for joints and with the hammer test for cracked pipes or bells.

We put the pressure gauge on a line of main having three inches pressure, after the period which we allowed (I think twenty-four hours) and on first looking we thought that the pressure had not only not gone down, but had gone up, but we found we

had a vacuum of two inches. Therefore I think the pressure gauge is not a good test to use on mains.

MR. MAYERS:—I have noticed that in some places the soil has a very bad effect upon wrought iron pipe. We have a fifteen-inch main which had not been used for some time, and we sent the foreman down a couple of days ago to see that the gate at a certain point was in working order. He found that the gate, which was of steel, was all right, but on taking out and examining the pipe he found that it was corroded to such an extent that it had to be taken out and a new pipe put in.

Nothing has been said in the paper about putting in special fittings at intersections. It strikes me that we have so often to change the direction of a pipe in extending mains that in any particular place where you are required to lay an absolutely straight line it would be better in laying a small main, up to eight inches, to avoid putting in any specials for intersections, so that in future when you want to change a main you will not have to put in a special setting at each point.

MR. EGNER:—I think that Mr. Forstall has given us a remarkably well-written paper. While he was reading it I was reminded of nothing so much as of a paper read by his respected father many years ago, on purification. I move a hearty vote of thanks to Mr. Forstall for this paper.

THE PRESIDENT:—I think Mr. Forstall would like to say something in reply to the suggestions and inquiries which have been made, and he has the opportunity.

MR. WALTON FORSTALL:—Referring to the criticisms upon the methods of connections, as I stated before, the scheme is open to objections, and we may change it ourselves after a while.

In reply to what Mr. Littlehales said about rushing the work too much, and also to the criticism of Mr. Miller on the same subject, it is of course understood that *good* work should be done at all times, but as *fast* as possible. Mr. Littlehales also spoke of no provision being made in the specifications to cover the replacing by good dirt of any ashes found. In the city for which these specifications were designed there were no ashes encountered, and therefore the specifications did not need provisions for them.

In reply to his inquiry about allowable leakage, I may say that my experience in this direction has been rather limited. Some

years ago in beginning to reduce the leakage on about twenty miles of main in a country town, I started with the idea that we could get it down to 33,000 feet per mile of three-inch main per year; but before I got through I was satisfied with anything under 100,000 feet, and I believe that most people are of the same opinion. In one or two cases however, in testing sections which had been isolated by valves, I found the leakage only about 35,000 feet per mile of three inch main per year, no work having been done on the section, and of course I let it go at that.

Mr. Jenkins spoke of preferring cast iron for four-inch services to wrought iron, because of longer life. We decided to use wrought iron on account of the many obstacles that would in most of the places be found between the main and the curb where the four-inch services would have to run, and not caring to put in the number of lead joints that might be needed with cast iron in such a place.

Replying to Mr. Rusby's question as to how the twelve-inch plug was taken out, I will say that we used a thirty-six inch bag in the arm of the cross, and this stopped most of the gas. Of course it would not have been possible to have used this thirty-six inch bag for taking out the thirty-six inch plug.

Mr. Miller said that the weights of mains were not adopted as a standard by the Society of Gas Lighting, but only recommended as desirable. This may be, and yet I once received a lot of pipe of the same weight as that recommended by the Society, without having specified any weight, showing that that foundry regarded this weight as standard.

Mr. Miller did not realize that the rubber gasket was only in temporary contact with the gas, as after the connections were made, the temporary piece on which it was used was thrown away.

With regard to the stringency of the specifications, I will say that they are the result of a great many misunderstandings with contractors which forced us twice in succession to make our specifications more stringent, and that after using these specifications we had very few misunderstandings with our contractors. It seems to me that one of the great advantages of contract work is that it enables us to know ahead of time the cost of any job, and if your specifications permit of many extra charges this fore-

knowledge is lost. For my own part I believe that a company should do all its own work.

In reply to Mr. Humphreys' remark about the unreliability of the pressure test, I will say that every good main foreman tests his pipe with a hammer before it is laid, and in the pressure tests all joints are gone over with soap suds.

In reading the mercury gauge of course regard must be had to temperatures.

Mr. Mayers spoke about the omission of any suggestion as to the settings of specials for intersecting mains whose future location was in doubt. This is another question of personal opinion, whether, except in large mains, specials should be set at all under such conditions. In large cities gas companies generally have a certain right of way assigned them, so that specials can be set at that distance from the curb, knowing that they will be in the right place when wanted.

Mr. Neal:—I would like to ask Mr. W. Forstall how he connects his services with the mains, directly, or by an offset.

Mr. Walton Forstall:—We use in that case a street Tee with a male thread on one end of the run, a female thread on the other, and a female thread on the outlet. We use a Tee rather than an elbow, because we have a little rubber plug which fits into the end of the Tee, and after a man has tapped a hole in the main he shoves the plug down into the Tee, and stops the flow of gas. If you have not been able to work your service from the main, but have to work from the house out, and have a difficult connection to make with a union, the pipe being under more or less strain, it makes a great deal of difference to a man whether he is bending over a flow of gas or not.

Mr. Neal:—You do not understand me. My method now is, on account of the drawing out of the nipple in the main, to put in an elbow, and then a very short nipple parallel to the pipe, and then another elbow connected with the service. This allows a little movement if necessary. That has been my practice now for many years, and has resulted from the experience I have had with services drawing out the mains. Do you do that?

Mr. Walton Forstall:—I tried to explain that by saying that we made use of the street Tee. Into the outlet of the Tee

we put the male thread of a street elbow. In this way we get a swing joint, and without using any nipples.

MR. W. A. MILLER:—Why does Mr. Forstall use a rubber gasket rather than a flange connection?

MR. WALTON FORSTALL:—I do not quite understand your question.

MR. W. A. MILLER:—I ask why you do not think it preferable to use a blank flange piece, bolted to a piece of flange pipe instead of using your rubber gasket. You have now a piece of double flange pipe, with a rubber gasket and the flange clamped to it. Instead of using that would it not be better to use a pipe with a flange at the end, and bolt the other flange to it?

MR. WALTON FORSTALL:—One answer to that question is that we had this pipe on hand, and we used it. We did not regard this temporary piece as anything but a tool. It was in service only two or three hours. If we had not used this we would have had to buy a piece of pipe for that purpose. The piece was thrown into the scrap pile when we got through with it, because that was the only connection of that kind we had to make.

MR. LITTLEHALES:—I will say, with reference to leakage, that I think Mr. Forstall is about right when he says that 100,000 cubic feet per mile per annum would be a good standard. The lowest, so far as any records I have been able to have access to figure out 229 cubic feet per mile per day. Mr. Forstall's figures are 274 cubic feet. So they come very closely together. The worst I have ever known was 1,935 cubic feet per mile per twenty-four hours.

Now some consider that they must reduce it all to one size, but inasmuch as from eighty to ninety per cent. of the average mains of different companies will be six inches and under, the mere taking of the mileage as it stands, and dividing by the number of miles, gives results sufficient for all practical purposes. I found from a number of records to which I had access that from eighty to ninety per cent. of the total mileage was six inches and under, and taking it upon that basis the worst I have ever known is 1,935 and the best I have known is 229. My belief is that anything that comes down to that is about as near perfection as we can hope to attain.

MR. EGNER:—I renew my motion of a vote of thanks to Mr. Forstall for his paper.

(Carried).

THE PRESIDENT:—There are two Committees yet to report: that on the next place of meeting, and that on the President's Address.

Mr. C. J. R. Humphreys read the following report:

Your Committee appointed to recommend the place for the next meeting of the Association beg leave to report as follows:

Your Committee would acknowledge with thanks the invitation to hold the next Convention at Hartford, but the sentiment of the majority of the members of the Association, as expressed to this Committee seeming to be in favor of New York City, your Committee would recommend that the next meeting of the Association be held in New York City.

Respectfully,

C. J. R. HUMPHREYS,

E. H. JENKINS,

L. L. KELLOGG.

On motion of Mr. Neal the Association approved the recommendation of the Committee.

Mr. Boardman read the following report of the Committee on President's Address:

Mr. Chairman:—Your Committee appointed to report upon the President's Address has been greatly pleased with the many points of interest treated therein and the living issues discussed. It is difficult to select from a paper so replete with suggestions those most profitable to consider.

However, we respectfully impress upon this Convention the pertinent remarks of the President upon the menace to private property of the attitude of many municipalities in their efforts to acquire the public utilities' works. This desire on the part of the people is very wide spread, and is intensified in many instances by designing politicians for selfish ends.

Believing, as we do, that this movement is consequent upon erroneous ideas of the ultimate economies to the community, and mistaken and imperfect reports from those municipalities operating gas, water and electric works, we deem it important that the

members of this Association should post themselves thoroughly upon all the points bearing on this subject, so as to be prepared to refute the errors into which the people are being led, and to point out the omissions and inaccuracies in the reports creating these false impressions. If charged with taxes, state, county and municipal, with interest upon the cost of the plant, with depreciation and such other proper items as the privately owned plants are subjected to, the municipally owned plants would show a far greater cost to the community than is popularly believed.

Hence, we would recommend that the officer to be in charge of the Educational Work of the Association be also entrusted with collecting and compiling for ready reference the statistics and arguments on both sides of this question, published throughout the country, for the use and information of the members of the Association, and that each member aid the officer by sending to him marked copies of publications bearing on the subject that may appear in his locality.

We have considered with deep interest our President's review of the question of educating young men for the gas profession, and we are glad to agree with him in his approval of some plan for accomplishing this much desired purpose, and would respectfully recommend the Educational Committee to carefully consider this question. But if your Committee is competent to offer suggestions, we would respectfully say that we approve of the plan proposed by the Educational Committee, as that plan reaches immediately those who wish to learn and are already engaged in the practical work of supplying gas to the public. The plan proposed by the Educational Committee is similar to the system of education in use by the University of London: young men anywhere in the British Islands can study at home such subjects as are recommended by the University, and at stated periods go to London for examination by the Faculty, and degrees acquired by this process are very highly valued. The plan pursued by some of the correspondence schools in this country might be examined with advantage.

Attention is called to the danger of our mains and services from the electrolytic action of street railway currents. Although much has been written in the past upon this subject, it is probable that an additional paper giving practically and in very full detail the

methods of testing our mains for the existence of current, how to suppress it, the points in our main system especially liable to injury, etc., would be of service to our members.

We recommend to the Association the preparation of such a paper.

Respectfully submitted,

A. E. Boardman, *Chairman*,
John McIlhenny,
David H. Geggie,
B. E. Chollar,
J. M. Rusby,
Committee.

On motion of Mr. Neal the report of the Committee was accepted and its recommendations adopted.

The Secretary:—One of our most active members, who is not only a member of, but also the President of the Western Gas Association, in writing me a few days before this meeting, said, that as neither he nor Mr. Dunbar, the Secretary of that Association, would be able to be present at this meeting, he would like me to extend to the American Association the cordial invitation of the Western Association to attend their Convention at Milwaukee on the third Wednesday of May next, either in a body or individually, and he bid me assure you of a hearty welcome. I take great pleasure in conveying Mr. Thompson's invitation to the Association.

Mr. Butterworth:—I move that the Secretary of this Association be instructed to send the following telegram in behalf of the Association:

To Mr. George Treadway Thompson:

The American Gas Light Association in Convention assembled at Niagara Falls, learns with deep regret that you are unable to meet with us on account of your illness. We miss you, and express our best wishes and hope for your speedy recovery.

(Carried).

The Association then took a recess until 2.30 p. m.

SECOND DAY—AFTERNOON SESSION.

The Association met at 2:30 P. M.

THE PRESIDENT:—The first paper to be read this afternoon is that of Mr. H. L. Rice, entitled, "A Gas Engine in a Blowing Plant."

(For paper see Appendix, page lix.)

MR. A. S. MILLER:—Mr. Rice does not make a very good case for the gas engine in his paper, and there is no reason why much better results could not be obtained. In order to make a thousand cubic feet of gas twenty-five hundred cubic feet of air is required. Assuming that the air is pumped against a pressure of twenty inches of water, the actual work on the air would be equivalent to 265 B. T. U. In practice it has been found that a plant can be easily and regularly run so that the work, as represented by the increase in pressure in the air, is equal to fifty per cent. of the indicated horse power of the engine. Assuming that the gas contains 700 B. T. U. per foot, and that the engine would run on eighteen cubic feet per hour per indicated horse power, which is a very liberal allowance, the actual gas that would be consumed in furnishing the blast to make a thousand cubic feet of gas would be something less than four cubic feet. The foregoing figures probably could not be obtained under the conditions of this test, but there is no reason why they should not have been easily reached if the blast pipe had been tight and the engine running to its capacity, no allowance being made, of course, for the gas consumed when the apparatus was not under blast.

MR. EGNER:—In giving us this paper Mr. Rice has selected (to the best of my recollection) an original subject, so far as papers presented to this Association are concerned; and in my opinion he has treated it with impartial fairness, and has given us some interesting figures. While it is true, as a previous speaker has pointed out, that gas companies apparently do not always practice what they preach—viz., they advocate the use of gas engines, yet do not to date use them to any great extent themselves—yet it seems to me there is a reason for this condition of things, and I think that reason ought, in fairness to others, to be given here at this time. We are all fully aware that gas is the cheapest material for the production of power, wind and water alone excepted, and we say so to our consumers. Then why do we not use it more extensively, and

why has it not been adopted before, especially when, as Mr. Rice has pointed out, it is apparently less costly than steam for the purpose described in his paper? The reason may be found in the fact that many gas companies find in the refuse material at their works more than enough fuel to raise the necessary steam—fuel which, if not used for that purpose, would only have to be carted away to fill in some low lands elsewhere, if not on the company's property. In my own experience I have found the generator screenings and the coke and coal breeze more than sufficient to keep up all the steam, not only for the blowers, but often for all other purposes besides. This was especially true at the Laclede Gas Works, where no other fuel than otherwise refuse coal breeze was used under the boilers. If not used that way it would more than likely be dumped overboard somewhere, making additional expense for hauling. This, however, in my time was a coal gas works for the greater part of it. But I have had like experience in at least two "all water gas" works. Others, no doubt, have had similar experience; all of which will explain why gas companies, while advocating—and justly so—the gas engine, do not use them to the exclusion of steam in all cases. As a general thing, however, they do use gas engines wherever possible. We used them at St. Louis for the office building elevator and for driving pipe-threading machinery, and I think they are still used there for that purpose. But, after all is said, I think Mr. Rice deserves a vote of thanks, which I shall move with much pleasure when in order.

The President:—Before that motion is put I think there are some others who would like to speak on this topic, and then probably Mr. Rice will have something to say in reply.

Mr. Searle:—Mr. Rice made his test of fuel economy on the same boilers that he used when the gas engine was in use for blowing purposes. He therefore of necessity had to use a larger boiler capacity than was necessary for steam with a water-gas apparatus. Had Mr. Rice so designed his plant as to have had a very small, say ten-horse, boiler, which would withstand a pressure of 500 pounds to the square inch, in which he could have raised the steam during the blowing operation to 500 pounds to the square inch, and let it run down while making a run, then on steam pipe to the generator have a governor to reduce the pressure to the inlet under his grate to his satisfaction, his fuel economy would have been

decidedly in favor of his gas engine. It is not fair nor just to a gas engine, nor to the steam plant, nor to the water-gas apparatus, to make a test for fuel efficiency on a boiler designed to furnish steam for a blowing engine and a water-gas set, then disconnect the blowing engine and use the same boiler to generate steam solely for a water-gas set.

Mr. A. E. Forstall:—Mr. Egner's point that at most gas works there is made a quantity of coke breeze, coal screenings, etc., that can only be disposed of by being burnt under the boilers, and that this makes steam engines more economical than gas engines for power purposes at such works is a good one as far as it goes. But there are few if any works that make enough fuel of this description to furnish all the steam required, and a great many new boilers are installed each year at various gas works. Why should not the gas engine be given the preference in all such cases, and arrangements be made not to furnish more steam, but to make the present steam plant sufficient by doing all extra work by means of gas power? In this direction there is a chance for the use of gas engines at gas works without interfering at all with the consumption of otherwise waste material.

Mr. Searle:—Further criticizing Mr. Rice's paper, I would say that the figures he obtained ought to all be calculated on cost of each item per 1,000 feet of gas made, and would then be more decidedly in favor of a gas engine for blowing plants, had the engine been designed with a third cylinder of, say, two-horse power capacity, which could have very easily been thrown into use by means of suitable valves, etc., during the time the water-gas apparatus was making a run. Then figure the cost per thousand feet of gas made for boiler fuel and the cost of gas for blowing per thousand cubic feet of gas made. I think these costs per thousand feet of gas made would be largely in favor of a gas engine for blowing plants. It is not just to the gas engine, nor to the subject, to take a sixteen horse power engine, which is only efficient at its maximum horse power, or thereabouts, and throttle it one-half or more of the time it is used to, say a duty of two to four horse power. Again, I want to emphasize the fact that using a gas engine with speed to be reduced by reducing the charge of gas, you do not get the compression in proportion to the gas contained in an explosive mixture of this composition, and therefore cutting seri-

ously into the efficiency of the engine. I fully agree with Mr. Rice that all gas engines should be equipped with gas as well as electrical igniters. I have never yet seen an electric igniter that would not get out of order at an inopportune moment.

MR. RICE:—I agree heartily with those of the gentlemen who have expressed the opinion that a gas company advocating the use of gas engines, should find a place for an engine in its own plant. This was one of the things we considered in installing our engine. It is a good thing to show people, to convince them that gas engines are all that we claim for them.

In regard to the economy figures of our engine, I may say that in actual blowing, the engine shows up in comparison very nearly what we estimated in advance of its installation. That we did not obtain finally the expected economy, is due to the greater average horse power required (in that the engine cannot be slowed down enough) and in uneconomical running at slow speed. The gas consumption should be more nearly proportional to the load, and that it is too high at no load, is probably due to an imperfect mixture in the cylinder at slow speed. The slowing down should be accomplished either by a change in the governor or by a third cylinder. With some such improvement as this, the gas engine may prove economical for blowing purposes, as well as convenient and consistent. It is certainly valuable, as one gentleman has suggested, and as we ourselves have experienced here, where the boiler capacity is inadequate. In regard to the underload on our engine, I may say that since this topic was written, we have started up a new and larger gas machine which requires the full horse power of this engine. The gas consumed per thousand has dropped most appreciably, and is now between 11 and 12 cubic feet. The machine has been in operation so short a time, however, that I cannot state the figures exactly, but state the fact to show that friction loss must be carefully considered in the tests given.

It is also to be remembered that in the comparison given we have a gas engine competing against a steam engine in a large plant where the steam for the engine is a small incidental; there is no extra cost for fireman or engine-man because the steam engine is operated; there is no less coal and ash nuisance, no less insurance, no less danger, whether the engine is operated or not. We cannot sell a gas engine in such competition, and we do not

try to. This topic was not intended to apply on the question of gas engines in small private plants. Such a question is very different because of the many savings outside of the coal pile which are then effected by the gas engine. We know—for small power plants—the gas engine, for a multitude of purposes, is the cheapest possible power with gas at even $1.30 a thousand.

MR. EGNER:—I now move a hearty vote of thanks to Mr. Rice for his excellent "short topic" paper; and I wish to say that, from the fair and clear way in which Mr. Rice has handled the subject, it is to be hoped he will favor the Associatton another time, and I hope to have the pleasure of listening to future efforts in that direction on his part.

(Carried.)

THE PRESIDENT:—We have another short topic paper, entitled "An Experience with the Shadbolt Self-Enriching Process," which will now be read by Mr. Irvin Butterworth.

(For paper see Appendix, page lxii.)

MR. EGNER:—I think we have with us to-day Mr. K. M. Mitchell, of St. Joseph, Mo., who read a paper on this subject at the last meeting of this Association. Perhaps he may be induced to say a few words on this subject. My recollection of the matter is that the Shadbolt process was not so much effective in increasing the illuminating power of the gas as it was in the prevention of naphthaline deposits.

MR. WITHERBY:—My experience with the Shadbolt process covers a period of about three years. I firmly believe that it will increase the candle power, but that it will not help our naphthaline troubles in the least. At one works where I installed it I returned the gas from the outlet of the second scrubber to the inlet of the exhauster. The distance between the two points was about 130 feet. The amount of scrubbed gas returned was about eight per cent. of the total make, and it increased the candle power from one and a half to two candles. I will admit that my authority is questionable, as all I had to test with was the jet photometer, which I do not consider the most reliable instrument in the world. But as that was the only thing we had to go by, it must be taken for what it is worth. We are sure of this much: that, with all conditions being equal—that is, weather about the same, amounts of coal, and heats in the retorts as nearly in the same condition as it

is possible to keep them, and with the by-pass in operation, and returning eight per cent. of the gas—the photometer reading would increase one and a half to two candles, and by closing it the photometer reading would drop again. It would take from four to eight hours to show the change either way. I feel sure that it is a help in increasing the candle power; but as to its being a preventive of naphthaline, I know by experience that we had just as much naphthaline while using it as we had without it.

MR. WALTON FORSTALL:—On my return from the meeting at Old Point Comfort I ran an inch and a half pipe from just back of the exhauster to the entrance of the atmospheric condenser. I think possibly I by-passed about ten per cent. of the make in this way. I found no diminution in naphthaline troubles. I could not tell about any effect upon candle power, because I had no bar photometer.

MR. EGNER:—The statements made concerning this subject so far are certainly perplexing. Trying the same thing in the same way, one gentleman finds that the process did not increase the illuminating power, when measured on a jet photometer, and that would seem to indicate that Mr. Butterworth's principal mistake was that he used the bar and not the jet, and that if he had only employed a jet photometer he would also have had an increase of illuminating power. He ought to make a note of this and get one. One finds that the process did clear away naphthaline deposits at the works, not elsewhere, and another found no difference at all. On the whole, the paper and the discussion leaves the Shadbolt self-enriching process pretty much where we found it; for with the contradictory statements now made no one can say as to this process whether it is or is not good for anything. It certainly was not any good at Columbus; but we must, however, always bear in mind that if Mr. Butterworth had only thought of the jet photometer his results might have been very different.

MR. W. A. MILLER:—Soon after my return to the Cincinnati works from the last meeting of the American Gas Light Association the necessary pipe connections were made to permit of returning about ten per cent. of the gas produced from outlet of washer-scrubber to inlet of multi-tubular condensers, hoping thereby to prevent the deposition of naphthaline in service pipes, which is the most frequent cause of complaint by consumers. The percentage

of gas returned from outlet of washer-scrubber to inlet of multi-tubular condenser was regulated to that desired by opening valve on return pipe sufficiently to increase the speed of exhauster ten per cent. per minute. (The different apparatus is arranged in the following order: Hydraulic main, air condensers, multi-tubular condensers, tower-scrubbers, exhauster, washer-scrubbers, purifiers.) The temperature of the gas under normal conditions at inlet to multi-tubular condensers was about ninety degrees, and the returned gas about seventy degrees. During several periods of time the temperature of the gas returned was raised to eighty degrees, to ninety degrees, and to one hundred degrees, by passing it through a coil of pipe heated by steam. The experiment was carried on for several months, but at no time was there any increase in the candle power of the gas attributable thereto, nor did it eliminate the naphthaline trouble in service pipes, and it was considered a failure.

THE PRESIDENT:—If there is no further discussion on this paper, Mr. Butterworth may wish to say something in reply.

MR. BUTTERWORTH:—You will observe that I tried the experiment in exactly the same way that Mr. Witherby says he tried it, and yet he reports a decided increase in candle power, while I found practically none whatever. I have simply given you the result of my experiment for what it is worth. I have had no theories on the subject except the one mentioned in the last paragraph of my paper, and that theory went glimmering in the light of the subsequent experiment described in the last paragraph. I suggest, in view of the contradictory results obtained by the different members with this process, that we refer it, as we do all knotty problems, to our Research Committee.

THE PRESIDENT:—We have one more paper on our list, "Can We Make All Our Business Pay?" It will now be read by Mr. A. E. Forstall.

(For paper see Appendix, page xxxv.)

MR. SEARLE:—Mr. Forstall has given us an ideal paper, but one, I fear, too hard and difficult to attempt to put in practice in the face of modern clamor. It is undoubtedly the most equitable method of dealing with our business, but to attempt to put it in force with an inconsiderate and exacting public would call forth enough odium to satisfy the most pugnacious Corbett! As an illustration

of the inequitable way of doing business, for sake of example, take a street railway which carries thousands of passengers per day; one man may ride a block for a nickel, while another may ride three miles Of course I see no way to prevent it, but it is certainly an inequitable way of doing business, that one person should be carried ten times as far as another person for the same money; but the attempt to remedy it would drive them out of business.

MR. LITTLEHALES:—The inequitable way of doing business in the illustration given by Mr. Searle is certainly not greater than that which exists in the postal service, and yet we all appreciate how admirably the great public is served by the adoption of a low and uniform rate of postage.

MR. SEARLE:—Replying to Mr. Littlehales, I would say that I firmly believe that our postal system is the most unjust and unsatisfactory service in our country. One man is charged two cents to send a letter around a block, while another man is charged only the same money to send a letter to San Francisco,

MR. BUTTERWORTH:—I want to express my agreement with Mr. Searle's view of this subject. While we would all welcome such a fair and equitable system of charges as is proposed by Mr. Forstall, yet I fear it is a refinement that is impracticable to successfully introduce into the gas business at the present time. An effort to do so would, in my opinion, result in serious complications, difficulties and dissatisfaction. The present state of affairs in this particular will probably continue with us. viz., that the large consumers fix the price of gas and the small ones get the benefit of it. I will say in reply to the point raised by Mr. Forstall, that while we do not in Columbus refuse to set a meter and furnish gas to any applicant, however small his consumption, we do make a service charge when the gas consumption falls below a certain minimum quantity. In this way we endeavor to avoid selling gas to any consumer at a loss to us. As a matter of fact, I believe that we and all other gas companies lose considerable money in selling gas to small consumers.

MR. A. E. FORSTALL:—I differ with Mr. Searle as to the difficulty to be encountered in putting in force, the plan advocated. If the change in Method is made at the same time as a reduction in price under the old system, I believe it would pass almost un-

noticed except by a very small class of undesirable consumers, whose business is now done at a loss.

Mr. Butterworth has found it feasible to make a service charge in the cases where such a charge figures out very high per 1,000 cubic feet. If it can be done in such cases, why cannot the rule be applied to the cases in which the adverse effect will be slight?

The cases that will be benefited will take care of themselves.

Of course a question of this kind is entirely a matter of opinion until the experiment has been actually tried. I seem to stand alone, but my conviction is unshaken, that the plan is not only ideal, but also perfectly feasible.

MR. SEARLE:—I want to say that the antagonistic criticism or discussion of the papers brought before this Association does its members more good than an eulogy. Two or three of us may say that the writer of a paper is wrong in his idea, and by so saying make him more firmly determined to go home and prove that he is right, and thus benefit the Association and himself to a much larger extent than were he flattered and so self-satisfied that he would not write for the Association again, and lose the real benefits of his subject to himself.

I am sure the magnanimous spirit which prompted Mr. Forstall to write this ideal paper, and prompts others to write for this Association, makes him feel well paid for the trouble, and that he is determined, and I hope will carry out its suggestions sometime in the future, and demonstrate to the people who have discussed this paper derogatorily that they are wrong and that he is right; that his idea is not only possible, but is in satisfactory operation.

Upon the invitation of the President, Mr. Allen Ripley Foote addressed the Association with reference to a proposed

PRESS SERVICE.

MR. FOOTE.—In explanation of the work I have been doing for the past year, and of the work which I propose to undertake for the year 1899, I will say that I have been receiving the press clipping service that is furnished by the Chicago Press Clipping Bureau. In examining these clippings I find almost invariably that whenever an item is started that is detrimental to public service corporations it has the run of the papers, and I receive from fifty to a hundred copies of that clipping. On the other hand, when-

ever an item appears that is favorable to public service corporations I get it but once, showing that it is not copied by the press. I do not find that the copying of articles detrimental to public service corporations is confined to any class of publications. It seems to be the fashion to do this by the publications of all parties. This, to my mind, is an indication that the only reason such clippings are republished is because the publishers of papers regard such material as the kind of reading that is popular and helps to sell the paper. I think that the papers of this country would as readily print clippings favorable to corporations if they recognized in them good material for popular reading.

After studying this matter for some time, I have decided to undertake to establish a press service for the purpose of securing the publication of items that are favorable to corporations. It is my intention to take from the clippings received each week all those that I judge would be serviceable to corporations, if reprinted, and to supply such other items as may be placed at my disposal. On Saturday of each week I will mail an envelope containing the clippings to be sent out to the local manager of every public service corporation in the United States, meaning by this all privately owned and operated water works, gas works, street railroads and electric lighting works. The copy sent out will be selected for its value as a means of diffusing correct economical instruction on questions of public policy among those whose votes are now, and must continue to be, sought for the settlement of questions involving the welfare of taxpayers and users of industrial public services. It is chimerical to expect such questions to be correctly settled in municipal councils, State legislatures, the National Congress, or at the polls, by voters who are not correctly educated. The design is so to instruct popular thought that political action will favor industries springing from individual initiative and carried on by private enterprise, and to supply an antidote for economic fallacies now being taught to thousands of voters, designed to socialize industries by the confiscation of taxpayers' property and to facilitate this purpose by creating and perpetuating antagonisms between employees and employers, public service corporations and the users of the service they render.

The work undertaken is to correctly educate the forces that formulate public opinion and to apply the sound principle that correct education must precede correct legislation.

The local managers of corporations are requested to assist in carrying out this work by supplying, in return for what they receive, any items useful to the purpose that may appear in a publication issued in their town or city; by giving information and facts known to them that may be used to correct any false statement that may gain publication; by securing the publication in their local papers of all items sent to them, or such of them as they may deem locally desirable.

Local managers will at once see that, if each one will do his part promptly and continuously, no fallacy or false statement can appear without being promptly refuted or challenged through the columns of journals in every town and city in the country that are willing to publish the truth. By this means error may be suppressed and correct information disseminated.

Pamphlets will be published from time to time pertaining to the subjects under consideration. Authors of papers read before organized bodies and associations, of papers and magazine articles, are requested to submit their manuscripts for this purpose. These publications will be sold to local managers at special rates in any quantity desired for general distribution. Success will be measured by the number circulated.

By cordially co-operating in this undertaking local managers will keep themselves well informed and will gradually accumulate material that will be of high value and usefulness to them under stress of any public or legislative emergency they may be called upon to deal with. They will render also a public service to investors in the stocks and bonds of the corporations with which they are identified and will perform a needed public duty. If it is the duty of every person to speak the truth, it is also his duty to refute fallacies and to correct false statements that deceive the people to their injury.

I respectfully invite the co-operation of the members of the American Gas Light Association in this work.

On motion of Mr. Jenkins, the members of the Association were requested to co-operate with Mr. Foote in perfecting the service suggested.

On motion of Mr. Boardman, the hearty thanks of the Association were voted to the retiring President for his efficient and satisfactory conduct of this meeting of the Association.

The President, in acknowledging the compliment, expressed his appreciation of the assistance which had been rendered him by many members of the Association, and acknowledged his obligations to Secretary Forstall, on whom had devolved most of the labor in preparation for the meeting and to whose efficient services was largely due whatever had tended to make the meeting a success.

On motion of Mr. Shelton, the Committee of Arrangements were thanked for their contributions to the entertainment and comfort of the members attending the meeting, and Mr. Beal, in seconding the motion, called special attention to the prominent part which Mr. Jenkins had taken in successfully carrying out the plans of the Committee.

The Association then took a recess until the return from the excursion, on Friday afternoon, October 21st, when the final adjournment was had.

THE PROCEEDINGS

OF THE

American Gas Light Association.

TWENTY-SIXTH ANNUAL MEETING.

1898.

APPENDIX.

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NOTES ON MAINS AND MAIN LAYING.

WRITTEN FOR THE TWENTY-SIXTH ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION BY WALTON FORSTALL, PHILADELPHIA, PA.

WEIGHT OF PIPE.—In 1892 a standard weight for gas mains was adopted by the Society of Gas Lighting. Since that time, the constantly growing difficulty of obtaining proper cover in large cities, combined with the decrease in the cost of iron, have operated towards increasing the weights of the smaller sizes, so that no matter where a pipe is placed, it will be strong enough to stand the shock of street traffic, the idea being that instead of using the society's standard for the general run of work for which it is amply strong, and using heavier pipe for the exceptional locations that are constantly on the increase in cities, it is practically as cheap, and much more convenient, to have only one weight which will serve for all cases. Another reason for increased weight is the use of larger services, necessitating increased thickness of mains to give a sufficient number of threads in the service hole; and this has had much to do with fixing the weight of four inch and six inch in recent practice.

Below is the Society standard, compared with recent practice:

	WEIGHT PER LENGTH.		
SIZE.	Society of Gas Lighting.	New York City, 1894.	Philadelphia, 1898.
4 in.	208	216	228
6 in.	306	360	360
8 in.	471	504	492
12 in.	905	864	852
16 in.	1326	1344	1320
20 in.	1998	1776	1920
24 in.	2382	2400	2640
30 in.	3472	3240	3480

The difference in the case of 6 in. is quite marked, but the cost of increased weight is a comparatively slight percentage (about 5%) of the total labor and material cost, and should be considered a low premium for the insurance it affords of freedom from breaks even under trying conditions.*

METHODS OF CONNECTING SERVICES OR NEW MAINS TO EXISTING MAINS.—This applies to the many cases where the out-

*Since this was written, the Society has adopted a standard, and is now practically in line with recent practice.

lets of existing mains are too small or are not in the place desired, and new connections become necessary.

1¼ in. is the smallest service run, and all services to 4 in. inclusive are wrought iron. Any larger service would be cast iron and treated as a main. For all services a full size hole is tapped, except as now noted. An 1¼ in. in a 3 in. or 4 in. main, would have a ¾ in. or 1 in. hole respectively, the enlargement being made in the street ells. An 1½ in. service would be connected to a 3 in. or 4 in. main by a split sleeve tapped for an 1½ in. or 2 in. hole respectively. A 2 in. service from the same size mains would be connected by the same split sleeves as the 1½ in. service, this being done to prevent an excessive variety of specials. A 2 in. service from a 6 in. main would be supplied from an 1½ in. hole. A 2½ in. service from a 3 in. main would be supplied from a 4 in. x 4 in. tee. This involves a good deal of bushing, but is adopted because no more 3 in. mains will be laid, and the replacement of present ones is but a matter of a few years, so it is not considered advisable to buy any more 3 in. branches. A 2½ in. service from a 4 in. or 6 in. main would be fed by a split sleeve tapped by a 2 in. or 3 in. hole respectively, from an 8 in. main by a 2 in. hole tapped in the main. A 3 in. service from a 3 in. or 4 in. main would be supplied by a 4 in. x 4 in. tee, from a 6 in. or 8 in. main by a split sleeve with a 3 in. hole, from a 12 in. main by a 2½ in. hole tapped in the main. A 4 in. service from a 4 in. main by a 4 in. x 4 in. tee, from a 6 in. or 8 in. main by a 6 in. x 6 in. or 8 in. x 6 in. tee, as no more branches with 4 in. arms will be bought, there being little 4 in. main contemplated in future extensions. From a 12 in. and a 16 in. main, a split sleeve tapped for 4 in. would be used.

In connecting mains to mains, the idea is to use a saddle piece, otherwise called a hat flange, wherever the disparity between the two mains is very great, and the largest so large that a split sleeve with hub cast on would involve heavy cost. As the disparity and the size of the largest main decrease, split sleeves are used, and then in turn ordinary branches. A 4 in. main would connect by saddle pieces to 20 in. and over, by branch with 6 in. arm to 16 in. and under, except to 4 in., where 4 in arm would be used. A 6 in. main would connect to 30 in. and 24 in. by saddle pieces to 20 in. by split sleeve, to 16 in. and under by tee or cross. For an 8 in. the same rule would be followed. There

might be cases in which a 6 in. or 8 in. was to be connected to a 16 in., where local conditions would render a split sleeve preferable to cutting the main and inserting a branch. All mains of 12 in. and over to be connected by cutting out and inserting the proper special.

Below is given in tabular form, the scheme of connections just described. The idea is to have a standard system, so the necessary specials can always be kept in stock, and in order that the variety of these shall not be excessive, several are made to serve for more than one connection.

SERVICES TO EXISTING MAINS.

Size of Services.	SIZE OF MAIN.								
	30 in.	24 in.	20 in.	16 in	12 in.	8 in.	6 in.	4 in.	3 in.
Inch	Hole. Inch	Hole. Inch	Hole. Inch	Hole. Inch	Hole. Inch	Hole. Inch	Hole. Inch	Hole. Inch	Hole. Inch
1¼	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1	¾
1½	1½	1½	1½	1½	1½	1½	1½	Split sleeve 2 in. hole.	Split sleeve 1½ in h.
2	2	2	2	2	2	2	1½		
2½	2½	2½	2½	2½	2½	2	Split sleeve 3 in.hole	4x4 Tee	
3	3	3	3	3	2½	Split sleeve 3 in. hole.		4 x 4 Tee.	
4	4	4	4	Split sleeve 4 in. hole.		8 x 6 Tee	6 x 6 Tee		

For drawing and table of dimensions of Service Sleeves see Appendix at end of paper.

NEW MAINS TO EXISTING MAINS.

Size of New Mains.	Size of Existing Mains.							
	30 in.	24 in.	20 in.	16 in.	12 in.	8 in.	6 in.	4 in.
4 inch	Saddle Piece or Hat Flange.	Saddle Piece.	Saddle Piece. Split Sleeve.	Insert Branch.	Insert Branch.	Insert Branch.	Insert Branch.	Insert Branch.
6 inch	"	"	"	"	"	"	"	
8 inch	"	"	"	"	"	"		
12 inch	Insert Branch.	Insert Branch.	Insert Branch.	"	"			
16 inch	"	"	"	"				
20 inch	"	"	"					
24 inch	"	"						
30 inch	"							

For drawings and tables of dimensions of Hat Flanges and Hub Sleeves, see Appendix at end of paper.

METHODS OF MAIN LAYING—CONTRACT AND OTHERWISE.

When main extensions are made slowly, year by year, it is probable that most superintendents are both able and willing to do the work themselves, but if in any one season there are many miles of small size, or a few miles of large size to be put down, the temptation is great to let the work to a contractor, as it is often very hard to so expand the regular force as to care for this extra work speedily and well. If the ditching only is let out, the superintendent still has in his own hands the most important part of the job, from the leakage standpoint, and ought to feel sure of the tightness of his own work, but in all contracts of this kind involving divided responsibility, the division line must be clearly drawn so that in case of accidents from open ditches, the blame can be rightly placed. Contractors have been known to claim that where a ditch was ready for pipe on Friday noon, failure to lay this in the afternoon, so that backfilling could be done the next morning, rendered the company liable for an accident caused by the open ditch on Saturday night. In another instance, where one contractor opened the trench and removed surplus dirt after paving was complete, he claimed his responsibility ceased the moment the trench was bottomed and did not begin again until the paving contractor (who did the refilling gratis in order to be sure of his paving) was through, and the surplus dirt ready for removal. As this point had been provided for in the specifications, the company could not be held for the two accidents, the liability for which the contractor tried to fasten on them by this plea.

When it is deemed advisable to let the entire job by contract, a test under air pressure of (say) 2 lbs. is of great value, if only because of its moral effect on the contractor's men. It is possible to have a line tight under this pressure and yet for the caulking to be so poorly done that leaks develop in one winter, but an adequate number of capable inspectors will insure such personal acquaintance with the caulkers, that any unskillful or dishonest ones can soon be detected, especially in connection with the air test where every joint is gone over with soap and water by the inspectors, and any caulker whose work shows leaks is warned. In this way, either on contract work or where the company is doing a large job with many new men, it takes but a short time to weed out the bad caulkers. By observations of a mercury gauge the superintendent can assure himself of the tightness of the work,

independently of the inspectors' reports and no drop in pressure should be allowed. Air is preferable to gas solely because of the higher pressure obtainable.

Outside of the necessity for greater vigilance in order to obtain tight joints where contracts are let, there is the serious disadvantage, especially in large cities, of the indifference to the comfort of the public, that is so often characteristic of contractors. Their sole idea is profit and too often this is very small, for the bid has been made with great optimism, trusting that the company would not allow them to lose money on the job. So they let the surplus dirt pile up until it accumulates in sufficient quantity for most economical handling, they block up streets because they are too poor to buy lumber for sufficient bridges, etc. If such things are permitted the money value of the public favor lost by the company will much over balance any possible saving on the contract. It certainly pays to see that all work is done with the least possible annoyance to the public, and where loosely drawn specifications allow the contractor to save money in this way, the city authorities being indifferent, the company should, at its own expense, remedy matters, and drop that contractor forever. As an example of how tightly it was necessary to bind some contractors, I append a set of specifications which were used for about eighty miles of pipe in a large city, all the work being done by contract. (See Appendix at end of paper.)

The being able to have direct control of all details of work where there is contact with the general public, is the strongest reason in my mind, why a company should do all its own work, and fortunate the superintendent in charge of a company large enough to demand such a permanent force that it can serve as an efficient skeleton for any enlargement needed for great main extensions. The chief consideration in this case of company work is that of cost, for the question of excellence ought to be settled by the character of the permanent employees. There is danger that the company's foreman, accustomed to small jobs, often involving a certain amount of time to be "filled in," will be satisfied with a good deal less than an attainable day's work. Foremen habitually employed by contractors, whose rating depends directly upon their reputation for getting so much ditch dug or pipe laid per laborer per day, have the right idea from the cost side at least. To impress this same idea upon permanent employees, nothing is

so helpful as to keep close oversight of costs by a daily record both of labor and material for all large jobs, and weekly, fortnightly or at the longest, monthly records for small jobs. Two forms of such records accompany this paper (see Appendix) and have been found the means of imparting to the whole supervising force a realization of the value of each laborer's work and of the fact that their own worth to the company depended largely upon the figure at which they could keep the cost per foot of pipe laid. The men in charge of our large jobs, being college graduates, know enough arithmetic to realize that for a small quotient, a small dividend and a large divisor are necessary, and this knowledge makes them bend every effort to keep ditch ready for the derrick gang. In big cities, this often means getting out the laborers at 5 A. M. to open trench, that because of city conditions could not be dug the night before. Without the pressure of the daily cost report, the average foreman would not be alive to such necessity for extra working, and such men are the ones oftenest dealt with.

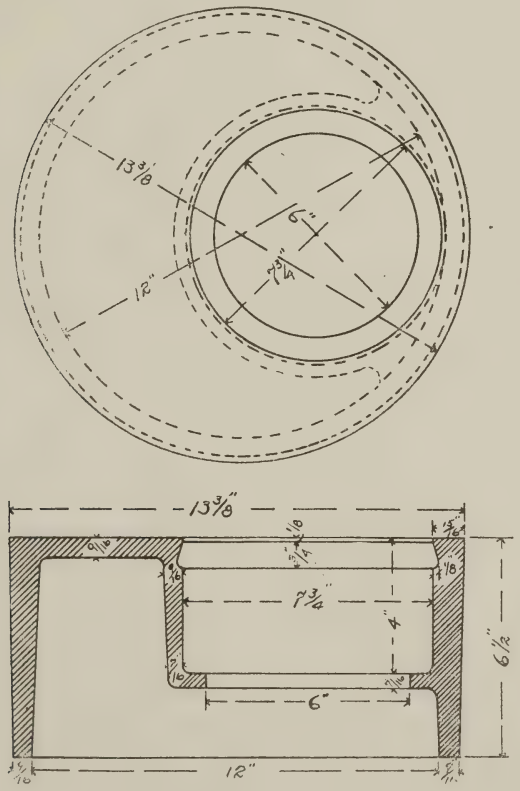
Where long lines of large pipe are to be laid and work has been begun at the cheapest end, it is interesting to watch the keen endeavor to keep down the increase in cost that naturally comes as more expensive conditions are encountered. This struggle is excellent training for every one on the job and is brought about with very little effort, for the figures for cost of labor and quantities of materials used each day are the only ones supplied by the time keeper, all additions for totals and cost of materials being worked out in the office by the stenographer. For convenience material is reported as *received* on the work, rather than as *used*.

Specials.—It is generally agreed that a large proportion of tees and crosses should be made with all hub ends. In this way, less pipe is left for the scrap pile, as at almost every intersection a spigot piece can be used in connection with an all hub special, and it is common experience that spigot pieces will accumulate faster than opportunities for their use solely in closing gaps with sleeves. Again, on paper you are often advised to have all branches made with bottom outlets, so that if desirable a large pipe can drain into a small one. These eccentric outlets also give a very desirable latitude in the placing of branches in a way similar to the bushings referred to later. These several facts, however, seem to be among those that people hear and then forget, for the all hub branches with eccentric outlets are too seldom met

with in gas practice. Where sewer or electrical manholes must be gone around, bends with two hubs make less detour necessary, as they can be laid snug against the obstruction, the caulking being all towards the latter. Offset pieces are not of much use in very crowded streets, as the necessary offset is seldom that of any fitting kept in stock. By using two bends and cutting one to measure, any offset can be obtained.

The fitting called a "bushing" has a use peculiarly its own, and may be unknown to some. As the sketch shows, it is formed by casting a hub *inside* a plug, the length of the bushing being the

12" x 6' Bushing.



same as the simple plug. Bushings have been made by casting a hub *upon* a plug, the length being that of the two combined, but such a fitting does not meet the conditions for which the real bush-

ing is designed, as now note. Large mains should be provided with outlets of generous dimensions, this being the safest practice. Suppose a 20 in. main, with a 20 in. x 12 in. tee, placed in the most available position at a street intersection, yet with a 6 in. water pipe running parallel with the 20 in., and so close to it that a 12 in. pipe could not be laid from the tee. Of course, if it was absolutely necessary to lay a 12 in. there, an attempt would be made to have the water pipe moved; but, as it happens, when there is need for a main in that street a 6 in. is considered large enough. The water pipe prevents the use of a reducer, but the 12 in. to 6 in. bushing takes no more room than the 12 in. plug, and the 6 in. hub being cast *eccentric* in the plug, allows a position that will clear the water pipe.

Records.—Every year increases the number of those using the card system for recording data, and where there is a large mileage, whose *exact* location is unknown, no better way exists of gradually collecting the desired information in shape for instant reference, than by service cards and street information cards, the former showing the main locations at every service, and the latter those at any other openings. Both sets of cards being filed geographically, it takes just two looks to settle whether anything is known of the mains at the desired point. By transferring the main locations from the service cards to street information cards, all main data can be filed in one place, but the advantage thus gained is seldom worth the work necessary.

The recording of new mains is a problem of almost as many solutions as there are solvers. With practical agreement upon the necessity for exact knowledge of location of all specials and bells, of curb distance and in minor degree of depth, there are many ways graphical or descriptive, or graphical and descriptive, of showing these. Some have sketches of specials only, which practically means all intersections, contenting themselves with a written record of intervening straight pipe. These sketches, entirely devoid of scale, are on cards conveniently ruled and are generally filed geographically, the method being well adapted to main laying done by the company's employees, where usually the foreman, to whose lot the record taking falls, is just skillful enough to make these sketches, especially when aided by rubber stamps representing all styles of specials.

It was the writer's good fortune to lay the first mile of a distri-

bution system and to work out the recording of eighty miles on a definite plan, conceived by his superior, so that at the end, every foot was shown on sketches and could be referred to in an instant. The unit was a city block, each with its own serial number shown on a key map of the city, and sketches were filed by number, in batches of one hundred. Each gave the main in plan and elevation, also curb elevations above mean high water, and the location of solid rock encountered. The original drawings were made on thin bond paper, blue prints from which formed the working file, the originals being preserved in fire-proof quarters. As every new line was planned, numbers were assigned to each block, and a survey made of the ground to obtain curb elevations and distances from a fixed zero point. Field books were filled out with this information, the exact limit of each block sketch was decided on, and thereafter in all records and reports, the block number governed. All work was by contract and detailed record of earth and rock excavation as well as feet of pipe laid was necessary, but by use of the block number, work could be reported each day from any number of places without confusion arising, and at the end of the job, the record of costs under each number could be found and set down on the proper sketch, so that the maps showed costs as well as locations.

The maps were in use day after day and proved their great convenience for the conditions they were designed to meet. The company being a new one, could not possess the old service foreman who carries all main locations in his head. A main laid this week by the contractor, would next week be tapped by the company's service gangs, who had not the slightest idea of its location, and recently restored pavement was not a reliable clue, as there are openings galore in the streets of that city, and your main is probably hard against that of a competitor, so that exact depths and curb distances are essential to the service foreman. These were provided for him in this case by making rough free hand sketches from the working files, and carbon paper enabled three of these to be made at once. One was sent out with the service orders for that block, and came back when the work was done, to be filed with the other two which were to take its place when it wore out. These rough sketches were filed according to numbers exactly as were the blue prints, and when a request came for maps of such and such blocks, it was quickly seen whether the sketches

were there, and if not, some were made, and thus day after day the file of rough sketches increased until it was complete.

This was a system made possible by peculiar conditions, and worked out by a staff composed entirely of college men, and under similar circumstances elsewhere, its value would again be shown.

A Connection "Wrinkle."—Given a 36 in. x 36 in. cross in the line of the only supply main to a city, from which the gas cannot be shut off, thus preventing the use of bags in the main, and making impossible the removal of the 36 in. plug from the arm of the cross, how is a 24 in. main to be connected to this plug through a full sized opening?

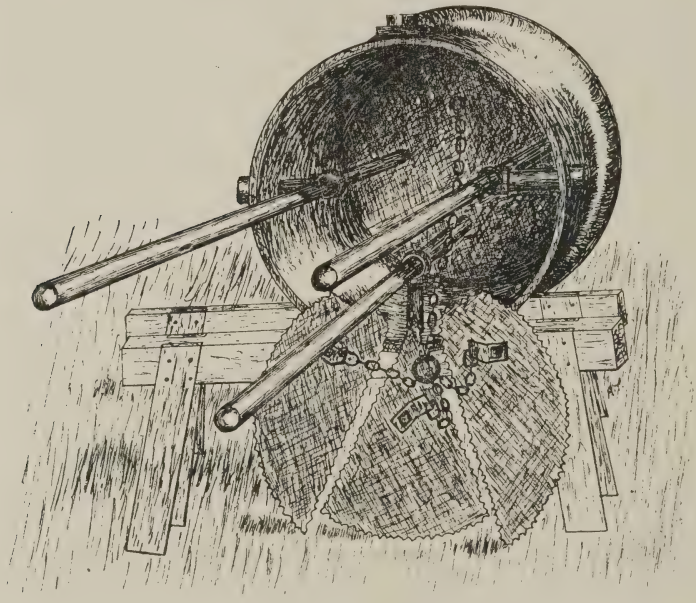


Figure 1.

The writer made four such connections, using the apparatus, a piece of 24 in. pipe arranged as hereafter described, shown in perspective in Fig 1. Fig. 2 is a longitudinal section showing everything in readiness to make the opening in the 36 in. plug. Fig. 3 shows the plug as drilled previous to tap bolting on a 24 in. flange piece, the outer row of holes being those for the bolts. The inner row and the two lines dividing the inner circle into three seg-

ments, are holes drilled as close together as was deemed safe, leaving just enough iron to hold the pieces in place. The full 24 in. circle could not be made, because the 36 in. plug was really a 36 in. x 12 in. bushing, and the 12 in. bell, which it was desired to leave intact, cut across the 24 in. circumference. As part of the 24 in. flange came upon the 12 in. plug, it was necessary in each case to remove the original plug, and substitute one of such length that it was flush with the face of the 36 in. plug. The drilling of the holes being finished, the flange piece three feet in length was secured to the plug, a 24 in. valve was placed in line, and to this was connected with a temporary joint, the special piece of 24 in. pipe, also about three feet long, prepared for this occasion and shown in Fig. 1. Its working (bell) end was closed by a plate of wrought iron clamped on a rubber gasket upon the face of the bell. This plate was pierced by four holes, through one of which passed a single chain, uniting three that were attached one to each segment of the inner circle.

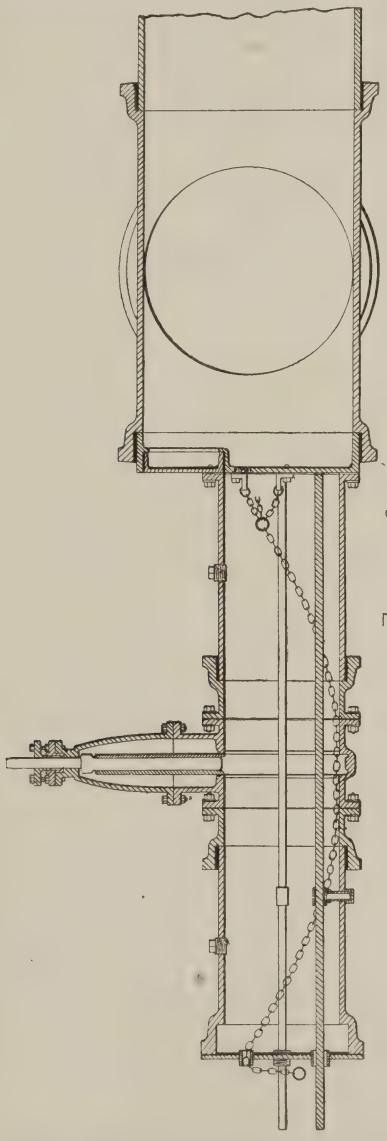


Figure 2

Through the other three holes passed iron rods guided through 1¼ in. pipe so arranged that each rod centred on a segment.

When everything was ready, the rods were shoved forward against the segments and struck with a sledge. This quickly knocked the segments loose and they were drawn by the chain through the flange piece and past the valve, and the latter then shut down. In this way two of the connections were made. Another was slightly easier, for circumstances favored bolting the

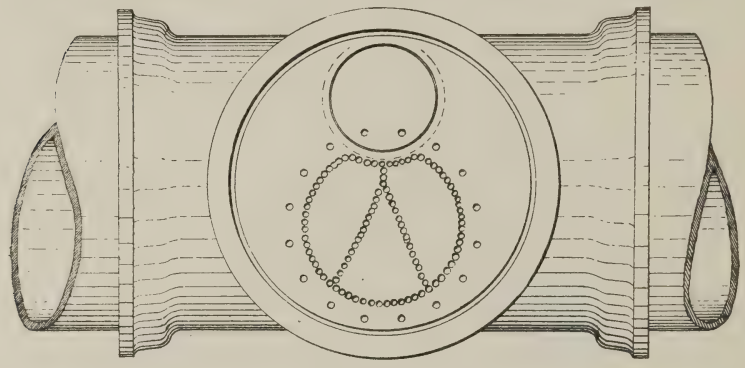


FIGURE 3.

valve directly to the 36 in. plug, so that there was only a short journey for the segments. The fourth connection was the hardest, for the valve could not be placed within twenty feet of the cross. In this case after the segments had been pulled through the flange piece into the temporary piece, a 24 in. bag was placed in the former, a 36 in. bag in the arm of the cross, the temporary piece was removed, and the line continued with more or less trepidation until the valve was set.

In almost every case the segments gave way at the first blows on the rods, and in this respect, and in the ease with which the pieces were dragged out, even across the valve, the work afforded pleasant surprises. To protect the valve seats, a piece of tin was used and afterwards fished out. Crude stuffing box arrangements prevented any escape of gas from the holes around the rods or chains. The men suffered only while drilling the many holes in the plug.

APPENDIX.

Service Sleeves

Note:
Detail Demensions same as
Std. Slit Sleeve.

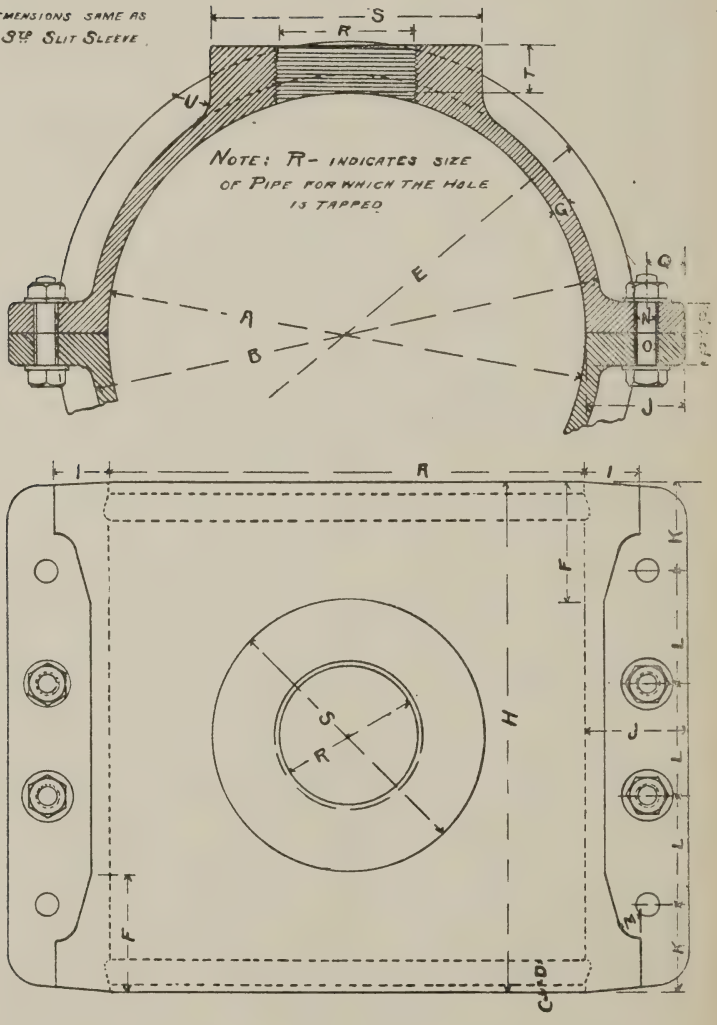
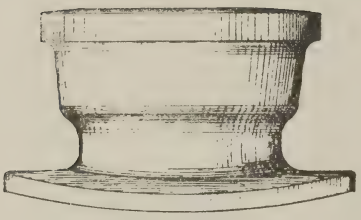
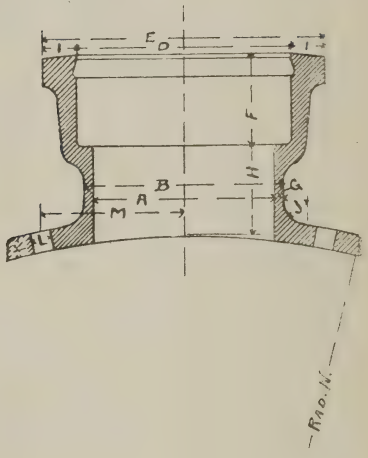


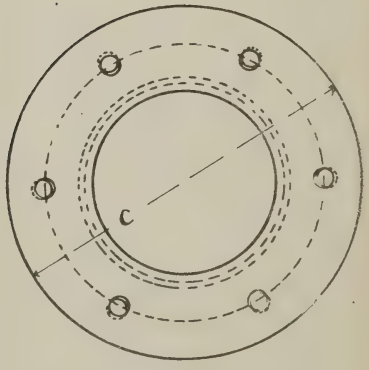
Table of Dimensions of Service Sleeves.

Size	3"	4"	6"	8"	12"	16"
A	4 5/8	5 5/8	7 3/4	9 3/4	14	18 1/4
B	5 3/8	6 3/8	8 5/8	10 5/8	15 1/8	19 1/2
C	1/4	1/4	1/4	1/4	1/4	1/4
D	3/4	3/4	3/4	3/4	3/4	1
E	6 7/8	8 1/8	10 1/4	12 3/4	17 1/4	21 3/4
F	3	3	3	3 1/2	3 1/2	4
G	3/8	3/8	7/16	7/16	9/16	5/8
H	15	15	15	15	15	18
I	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4
J	2 3/4	2 3/4	2 3/4	3	3	3 3/4
K	2 1/4	2 1/4	2 5/8	2 5/8	2 5/8	3 1/4
L	3 1/2	3 1/2	3 1/4	3 1/4	3 1/4	2 7/8
M	9/16	9/16	5/8	11/16	11/16	11/16
N	5/8	5/8	5/8	5/8	5/8	3/4
O	3/4	3/4	3/4	3/4	3/4	7/8
P	3/4	3/4	13/16	13/16	15/16	1 1/16
Q	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 5/16
R	1 1/2	2	3	3	4	4
S	3	4	6	6	8	8
T	7/8	1	1 3/8	1 3/8	1 1/2	1 1/2
U	15/16	1	1	1	1 1/16	1 1/16
Threads per inch on Boss	11 1/2	11 1/2	8	8	8	8
Weights. Minimum	43	65	95	120	187	296
Estimated	45	68	99	125	195	308
Maximum	47	71	103	130	203	320

HAT FLANGE.







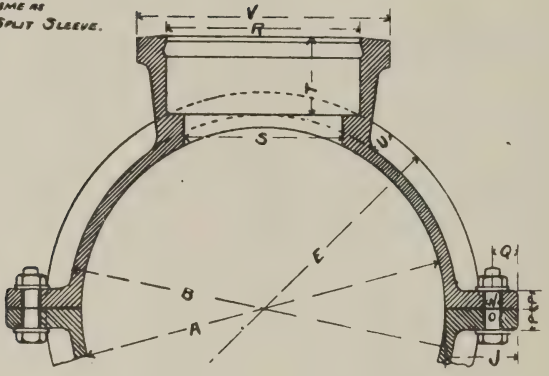
NOTE: DETAIL DEMENSIONS SAME AS STRAIGHT PIPE.

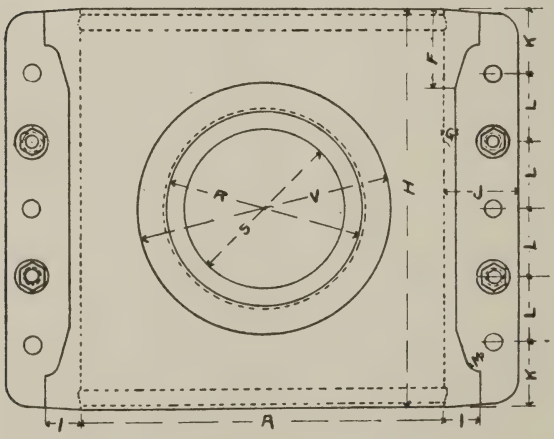
Dimensions of Hat Flanges.

Size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Weights. Minimum Estimated Maximum.
30" × 6"	6	$6\frac{7}{8}$	$13\frac{5}{8}$	$7\frac{3}{4}$	$10\frac{1}{2}$	4	$\frac{7}{16}$	4	$1\frac{3}{8}$	1	$\frac{7}{8}$	$\frac{7}{8}$	$5\frac{5}{16}$	16	67 70 73
30" × 8"	8	$8\frac{7}{8}$	$15\frac{3}{8}$	$9\frac{3}{4}$	$12\frac{3}{4}$	4	$\frac{7}{16}$	4	$1\frac{1}{2}$	1	$\frac{7}{8}$	$\frac{7}{8}$	$6\frac{5}{16}$	16	99 103 107

HUB SLEEVE.

NOTE:
DETAILS FOR HUB - SAME AS
SIZE STRAIGHT PIPE
OTHER DETAILS SAME AS
SIZE SPLIT SLEEVE.





MB.

Dimensions of Hub Sleeves

Size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Weights. Minimum / Estimated / Maximum
16" x 6"	18 1/4	19 1/2	1/4	3/4	21 3/4	4	5/8	18	1 3/4	3 3/4	3 1/4	2 7/8	11/16	3/4	7/8	1 1/16	1 5/16	7 3/4	6	4	1	10 1/2	314 / 327 / 340
16" x 8"	18 1/4	19 1/2	1/4	3/4	21 3/4	4	5/8	18	1 3/4	3 3/4	3 1/4	2 7/8	11/16	3/4	7/8	1 1/16	1 5/16	9 3/4	8	4	1	12 3/4	324 / 337 / 350
20" x 6"	22 3/8	23 3/4	1/4	1	26 1/8	4	11/16	18	1 7/8	3 3/4	3 1/4	2 7/8	3/4	3/4	7/8	1 1/8	1 5/16	7 3/4	6	4	1	10 1/2	589 / 614 / 639
20" x 8"	22 3/8	23 3/4	1/4	1	26 1/8	4	11/16	18	1 7/8	3 3/4	3 1/4	2 7/8	3/4	3/4	7/8	1 1/8	1 5/16	9 3/4	8	4	1	12 3/4	601 / 626 / 651

SPECIFICATION FOR LAYING GAS MAINS IN THE CITY OF ———.

LOCATION AND CONDITIONS.

The Gas Company, after determining upon the probable location for its mains in the various streets, avenues and public places in the City of ———, will inform the contractor or his agent as to such location, and the size of main to be laid therein. The Contractor, or his agent is then to make investigation of the conditions to be found in the given location, and is to base his prices upon such investigation, and upon the requirements of this specification.

No claims for extra payment on account of any work done under contract made between the Gas Company and Contractor, based upon this Specification, location given and prices named, shall at any time be entered or considered.

Such work not covered by contract as may be required to be done shall be executed by Contractor—ONLY—on instructions given by written memoranda, over the signature of the Engineer of the Gas Company, or such officer as may be appointed to represent said Engineer, and at a price to be agreed between the parties, prior to the execution of said work.

DIRECTION.

All work shall be executed under the direction and to the satisfaction of the Engineer of the ——— Gas Company, or such officer or employee as may be appointed to represent said Engineer, and in strict accordance with the ordinances, extant or hereafter instituted, of any of the City Departments of the City of ———. In the event of any discussion arising as to the signification of any portion of this specification, or as to the best method of executing any portion of the work, the judgment and decision of the Engineer of the Gas Company shall be final, and shall be so accepted by the Contractor.

SALARIES OF INSPECTORS.

Any costs for inspection imposed by any of the City Departments, City of ———, upon the work to be executed, being exe-

cuted or after execution by any Contractor, shall be charged to said Contractor, and entered against him on account of the contract for said work.

CHANGES.

Changes made at any time or for any reason in the exact location between the building lines of any street, avenue or public place, or in the depth below the pavement or surface of ground, of any main, shall in no wise invalidate contract, nor justify any claims for extra payment.

ALTERATIONS IN EXISTING MAINS AND SERVICES.

Whenever it may be necessary to alter or replace any existing main or service or portion of any main or service of any other company or corporation, whether supplying Gas, Water, Steam, Electricity or any other commodity, or any sewer or connection to sewer, same shall be executed under direction of the Engineer of the Gas Company by the Contractor and at the Contractor's own expense; but whenever such work may be done only by such other company or corporation, the same shall be executed under the direction of the Engineer of the Gas Company, who shall certify to the correctness of the charge for same, a copy of which shall be sent to the Contractor immediately upon its receipt by the Gas Company, and the Gas Company shall have the right to pay such charge within ten (10) days thereafter, and to charge same against the Contractor's account, and deduct the same from any moneys due or to become due to him hereunder.

MATERIALS, LABOR AND TOOLS.

All mains, pipe and specials shall be of cast iron. All castings of every description shall be furnished by the Gas Company to the Contractor at one of the storage yards of the Gas Company in the City of ———, or ex-boat, or on dock, in the City of ———, as delivered by maker. All other material necessary for the proper construction of mains, including lumber for bridges and sheathing and protection of trenches, lead and yarn for making joints, and blocking on which to rest castings, shall be of the best quality used for the purpose, and shall be furnished by and at the expense of the Contractor, subject to inspection and approval of the Engineer of the Gas Company. Contractor shall furnish all labor and all tools necessary for the proper execution of the work covered by

contract, and should any employee of Contractor seem to be executing his work in a careless or improper manner, or should he be conducting himself in a manner prejudicial to the interests of the Gas Company in the estimation of the Engineer of the Gas Company, he shall be at once removed by Contractor upon the direction of said Engineer.

DISTRIBUTING PIPE AND CASTINGS.

The Contractor shall receive all pipe and special castings from the Gas Company at one of their storage yards, or at the dock City of ———, at which delivered by makers and shall be liable for any expense incurred by reason of delay in unloading boat; shall transport same at his own expense to and distribute along the street, avenue or public place in which to be laid. The contractor shall be responsible for and make good all loss by breakage, thieving, or other cause from the time pipe and special castings are delivered to him at any of the above localities until laid and covered in by backfilling of trench, as hereinafter described, or are returned to one of the storage yards of the Gas Company.

The Contractor shall carefully examine each piece of pipe and special casting before receiving same from the Gas Company, in order to satisfy himself that the same is sound, and after having once accepted same shall claim no resource against the Gas Company for expense of distributing same, in case it be subsequently found defective.

TRENCHING.

The exact location of trench from curb line or other points shall be determined upon by sounding or digging test holes ahead of the trench, such sounding to extend sufficiently far in advance of the actual trenching not to cause delay by reason of changes in line (hence in permits) made necessary by the precise conditions discovered by the test holes.

Sufficient pavement shall be taken up to permit the opening of trenches of proper width for the various sizes of pipe as given hereinafter; all paving to be carefully preserved and piled neatly along side of trench. Earth and other matter removed is to be neatly heaped so as to give least possible obstruction to teams and pedestrians.

In cross streets, in addition to the bridges required by ordinances, a bridge shall be furnished across trench every 200 feet, so

that proper access to foot walk be given for vehicles. Trenches, wherever possible, shall be of sufficient depth, when in earth, to to permit the body of pipe to lie directly on the undisturbed earth at bottom, and give three (3) feet of cover for pipe (i. e. three (3) feet from top of pipe to surface of pavement); bell holes shall be dug to give proper access to joints for caulking. In each hole back of the bell. a block shall be placed resting upon undisturbed earth. This block shall be in length not more than eight inches shorter than width of trench, not less than six inches wide, and of sufficient thickness to take bearing of pipe as above. Trenches, wherever possible, shall be of sufficient depth when in rock to leave a space of not less than four inches from bottom of pipe to highest projection of undetached rock in bottom of trench, and give three feet cover as above. Two blocks shall be furnished for each length of pipe to give a bearing from undisturbed rock; one shall be placed about one foot back of bell, the other about four feet from spigot end. These blocks shall be in length, not more than eight inches shorter than width of trench, not less than six inches wide, and of sufficient thickness to raise pipe to proper grade.

Contractor will, whenever necessary, protect trenches by proper sheathing or other means, and will furnish adequate support, by proper shoring or chaining, for all pipes or other property, the safety of which may be endangered.

LAYING PIPE AND SPECIALS.

The Contractor shall carefully examine and clean each piece of pipe and special casting before placing in trench; any piece of pipe or special casting found cracked, broken or defective, must be laid one side subject to the inspection of the Engineer of the Gas Company.

The pipe shall be so placed in trenches that the line be kept straight, and at an even gradient wherever possible, and with the distinguishing mark on upper side.

In every case pipe shall have positive bearing on blocks specified above in preparation of trench. Each spigot shall be set into bell with which it joints, so that no portion of the end of spigot lies nearer than one-quarter inch, nor further away than one and one-quarter inches from bottom of bell, and so that the space from outer surface of spigot end to inner surface of bell be accurately equalized at every point of the circumference.

In the space formed as above strands of clean yarn shall be carefully rammed, until space is filled to give the lead depth required for the size of pipe, and sufficiently firm to cause the yarning tool to spring back when impinged against it.

For 4 inch diameter pipe, lead joint to be 1½ inches deep.
For 6-inch diameter pipe, lead joint to be 1½ inches deep.
For 8-inch diameter pipe, lead joint to be 1¾ inches deep.
For 12-inch diameter pipe, lead joint to be 1¾ inches deep.
For 16-inch diameter pipe, lead joint to be 2 inches deep.
For 20-inch diameter pipe, lead joint to be 2¼ inches deep.
For 24-inch diameter pipe, lead joint to be 2¼ inches deep.
For 30-inch diameter pipe, lead joint to be 2½ inches deep.
For 36-inch diameter pipe, lead joint to be 2½ inches deep.

In sleeves or wherever else it may be considered necessary to increase these lead depths, same shall be done on instructions by the Engineer of the Gas Company, without extra charge or allowance.

The "snake" or "clip" for holding lead in joint during pouring shall be so set that after joint be poured and clip removed, the lead on its outer circumference shall be flush with face of bell, and on its inner circumference shall extend not less than one-half inch beyond face of bell. This extension is to be carefully driven back into bell until caulking brings lead flush with face of bell at every point.

Necessary lead for joint must in every case be supplied in one continuous pouring.

DRIPS.

Wherever it may be necessary to locate drips for proper drainage of the mains, the type whether "line" or "side" will be determined by the Engineer of the Gas Company. The necessary excavation and the setting of all castings and wrought iron fittings, and making of all joints, whether in castings or wrought iron fittings, shall be executed by the Contractor.

All castings and wrought iron pipe and fittings shall be furnished by the Gas Company.

All material necessary for making joints as above, shall be furnished by Contractor.

TESTING.

All mains shall be carefully tested for leakage by filling same with air under pressure before backfilling trenches. As far as possible the mains shall be laid in sections, permitting the use of hand pumps to supply the air under pressure for testing. For this

purpose the Contractor will supply himself with suitable pumps and necessary fittings. He will supply labor to operate pump in raising pressure to not less than two pounds per square inch. All special joints required to be made and removed for the purpose of testing, will be executed by the Contractor at his own expense.

The Engineer of the Gas Company, or some employee appointed to represent said Engineer, shall be present at every test. The necessary labor for locating leakage, by going over the work with soap suds, or by other method as may be directed by the said Engineer, and for correcting same, shall be furnished by Contractor. No test shall be considered complete until satisfactory to the Engineer of the Gas Company.

When a defective casting is developed by any test, the cause for which is clearly the result of improper material or workmanship employed by the maker, and not discoverable prior to placing in trench, the same shall be replaced by the Contractor. The costs of this replacing shall be accurately taken by the Gas Company, and an equal allowance be made the Contractor; this allowance to include only actual expenses for labor and material used in executing the replacement.

When necessary to supply air in large quantity, steam pumping engine owned by the Gas Company shall be loaned Contractor without cost; all teaming, labor, fuel and repairs necessitated by its use shall be supplied by the Contractor at his own expense.

BACKFILLING.

All material taken from trenches shall, so far as possible, be returned to same upon backfilling. Any residue shall be removed by the Contractor immediately upon the completion of backfilling at point where residue is found. In backfilling, earth only may be used for a space of not less than six inches all around pipe and castings, this to be carefully tamped under and around pipe so that proper bearing be given without lifting pipe from its bed as laid; all backfilling to be thoroughly rammed either continuously as thrown into trench, or in layers of not over four inches in depth.

REPAVING.

Whenever ordinances of Department of Public Works permit Contractor to relay pavement, this shall be properly executed with proper materials by Contractor at his own expense.

Where pavement must be laid by specific party under said ordinances, same shall be executed by specific party at the expense of Gas Company; pending such repavement Contractor shall arrange pavement temporarily in a condition satisfactory to the City authorities and to Engineer of the Gas Company.

In every case, the Contractor shall, after pavement is laid, keep same in proper repair at his own expense for one year from date of relaying; this proper repair to include any repaving made necessary on account of sinkage over trench. Whenever notified that any such repairs are necessary, the Contractor shall see that the work of repaving shall commence within forty eight (48) hours of receiving such notice, otherwise the Gas Company shall have the right to cause such repairs to be made, and to charge the cost thereof against the Contractor, on account of his contracts.

PROTECTION AND RESPONSIBILITY.

The Contractor shall carefully protect all property from damage by reason of the execution of work under his contract. The Contractor shall assume all responsibility for and insure the Gas Company against any and all damage to life and property arising by reason of the execution of work under his contract. In the event of his failure to settle such claims within a reasonable time, the Gas Company shall have a right to adjust same and charge the amount thereof against the Contractor's contract.

GENERAL.

The Contractor shall at all time execute work cheerfully, and with all possible speed; shall cause the least possible inconvenience to vehicles and pedestrians, and in case of any argument arising with any citizen or citizens, or servant or employee of any citizen or citizens, shall give way to the wishes of said person whenever same are reasonable, or may be carried out without serious cost or inconvenience.

Whenever it may be necessary for any reason to execute any portion or portions of the work at night, on Sunday or on holidays, such work shall be executed without extra charge or allowance.

No employee of the Contractor shall at any time by any act or word provoke any person; the penalty for any such provocation shall be immediate discharge.

The words "Gas Company" used in this Specification refer to the ——— Gas Company of ——— City, or its successors or assigns.

The word "Contractor" refers to persons or party with whom contract—based upon this Specification—is made, and whose signature or initials are found hereon.

PRICES, ETC.

Prices named shall cover work, as described here:

First—Excavation; per cubic yard. For Earth—This is understood to include sand, pebbles and pieces of broken rock, none of the dimensions of which exceed eight inches. For loose rock—This is understood to include all detached or loose rock and boulders of larger dimension than that covered by the specification for earth, which does not require to be broken up to enable it to be removed from the trench. And for solid rock—This is understood to include all undetached rock and boulders, which, in order to open trench properly, must be broken up by blasting, or other means, to enable it to be removed from the trench.

Second—Laying pipes and specials, per running foot. This to include all work under this specification—*i. e.* Distribution of Pipe, Removal of Pavements, etc., (exclusive of excavation only), and the Relaying of Pavement where Contractor is permitted by Ordinance of Department of Public Works to execute same. Where Contractor is not permitted to relay pavement, no reduction will be made on that account, the cost of the paving in this case being applied to and to entirely cover the cost of removal of special pavement in point.

Third—For setting Drips. Per piece, line drip or side drip.

PAYMENTS AND ESTIMATES.

Payments shall be made by check on bank of deposit on each alternate Friday afternoon, after date of first payment, which shall be the second Friday after the commencement of work under contract. These payments shall be based upon estimates made by the Engineer, of the work done to the night of the Wednesday preceding the day of payment. In no event shall the total amount paid to Contractor (this to include any charges which he may agree to have entered against him) exceed ninety per cent. of the

total estimate value of work done. The remaining percentage to be held by the Gas Company for the period of one year from date of completion of work under contract, at the expiration of which period it shall be paid to Contractor upon the endorsement of receipt in full of payment for work done under contract as per final estimate of the Engineer of the Gas Company.

The reservation in payments for work done is for assuring completion of work, and keeping same in repair for one year. In the event of failure on the part of the Contractor to complete the work in accordance with terms of contract (which contract shall include these specifications) then any sum remaining unpaid shall be forfeited to the Company, and retained by it as liquidated damages.

The estimates shall be calculated as follows:

First—Excavation—Earth, in cubic yards for a rectangular cross section of trench, where earth and loose rock only are found; the width of which for the various diameters of pipe shall be, viz.:

4 inch diameter, width 20 inch,
6 inch diameter, width 22 inch,
8 inch diameter, width 24 inch,
12 inch diameter, width 30 inch,
16 inch diameter, width 35 inch,
20 inch diameter, width 40 inch,
24 inch diameter, width 44 inch,
30 inch diameter, width 50 inch,
36 inch diameter, width 56 inch,

and the depth shall be equal to shortest measurement from surface of pavement to the top of pipe, as laid permanently in trench, for which calculation is being made, plus outside diameter of pipe, viz.:

Outside diameter of 4-inch pipe shall be considered 6 inch.
Outside diameter of 6-inch pipe shall be considered 8 inch.
Outside diameter of 8-inch pipe shall be considered 10 inch.
Outside diameter of 12-inch pipe shall be considered 14 inch.
Outside diameter of 16-inch pipe shall be considered 18 inch.
Outside diameter of 20-inch pipe shall be considered 22 inch.
Outside diameter of 24-inch pipe shall be considered 26 inch.
Outside diameter of 30-inch pipe shall be considered 32 inch.
Outside diameter of 36-inch pipe shall be considered 38 inch.

Where solid rock is required to be removed for more or less of the cross sections of trench, it shall be in width equal to the inner diameter of pipe to be laid in it, plus 24 inches, and in depth shall be equal to the dimension from the surface of pavement to the mean grade of rock as uncovered in the trench.

Loose rock; in cubic yards, for the actual volume of material removed from trench, without reference to any cross section whatever.

Solid rock; in cubic yards, for a rectangular cross section of trench whose width shall be equal to width of cross section given for earth where solid rock is found, and whose depth shall be equal to the shortest measurement from surface of pavement to the top of pipe, as laid permanently in trench for which calculation is being made, plus inner diameter of said pipe plus twelve inches less the dimension used for depth in calculation of earth excavation for same trench.

In all cases the space occupied by paving material, shall, in calculation of excavation, be considered as occupied by earth.

Excavation for drips, in cubic yards, when in earth and loose rock, for cylindrical volume equal in depth to actual required depth of excavation, and in diameter equal to inside diameter of drip, plus 12 inches, when in solid rock, for cylindrical volume, equal in depth to actual depth at which bottom of drip is set, plus six inches, and in diameter equal to inside diameter of drip, plus twenty-four inches:

Second—Laying pipe and specials; in running feet, measured in the trench when ready for backfilling.

Specials are to be measured double along centre lines included in the running length of mains only, and from face to face of bells between which they are included. No castings shall be considered as specials other than bends, branches, sleeves and valves. When necessary to cut and lay short pieces of pipe in order to properly locate special, this shall be done without extra charge or allowance. The length of main included in a line drip, shall be estimated as running feet of pipe, and not be measured double.

Third—Drips set; in number of pieces as set.

APPENDIX.

The lead room and weights of pipe appended here are given for the convenience of Contractor, in making calculations of quanti-

ties, etc., the Gas Company in no way binding itself to hold even approximately to these figures, although it is their desire and expectation so to do.

DIAMETER OF PIPE.	POUNDS PER FOOT.	POUNDS PER LENGTH.	LEAD ROOM.
4 inches.	18	216	$\frac{3}{8}$ inch.
6 inches.	30	360	$\frac{3}{8}$ inch.
8 inches.	42	510	$\frac{3}{8}$ inch.
12 inches.	72	864	$\frac{7}{16}$ inch.
16 inches.	114	1,344	$\frac{7}{16}$ inch.
20 inches.	148	1,776	$\frac{7}{16}$ inch.
24 inches.	200	2,400	$\frac{1}{2}$ inch.
30 inches.	270	3,240	$\frac{1}{2}$ inch.
36 inches.	360	4,320	$\frac{1}{2}$ inch.

FORM NO.

_____ COMPANY.

_____ GAS WORKS.

DAILY COST REPORT.

GANG NO. _____ AUTHORIZATION NO.

TOTAL							

REMARKS

_____ TIMEKEEPER.

FORM NO.

_____ COMPANY.

_____ GAS WORKS.

DAILY COST REPORT.

GANG NO. _____ AUTHORIZATION NO. _____

FOR 24 HOURS ENDING 6 P. M., _____ 189

LABOR	NO. MEN	WORK DONE		TOTAL WAGES		COST PER FT. PIPE LAID	
		TO DAY	TO DATE	TO DAY	TO DATE	TO DAY	TO DATE
TRENCH OPENED		FT.	FT.				
PIPE LAID		"	"				
TRENCH REFILLED		"	"				
PAVING REPLACED		SQ. YDS.	SQ. YDS.				
TOTAL							

MATERIAL	AMOUNT USED		COST		COST PER FT. PIPE LAID	
	TO DAY	TO DATE	TO DAY	TO DATE	TO DAY	TO DATE
PIPE	FT.	FT.				
LEAD	LBS.	LBS.				
YARN	"	"				
BLOCKING	SQ. FT.	SQ. FT.				
TOTAL						

REMARKS

_____ TIMEKEEPER.

Form No.

_____ COMPANY.

_____ GAS WORKS

LABOR ON MAINS.

_____ DISTRICT.

LAYING PERIOD ENDING 189

TIMEKEEPER.

Form No.....

.....COMPANY.

.....GAS WORKS

LABOR ON MAINS. .....DISTRICT.

LAYING. PERIOD ENDING.....189

SIZE	No. MEN	FEET LAID		TOTAL COST		COST PER FOOT PIPE LAID	
		THIS PERIOD	TO DATE	THIS PERIOD	TO DATE	THIS PERIOD	TO DATE
4 Inch							
6 "							
8 "							
12 "							
Total							

OVERHAULING

SIZE	No. MEN	FEET OVERHAULED		TOTAL COST		COST PER FOOT PIPE OVERHAULED	
		THIS PERIOD	TO DATE	THIS PERIOD	TO DATE	THIS PERIOD	TO DATE
4 Inch							
6 "							
8 "							
12 "							
Total							

REMARKS

TIMEKEEPER.

DEPTH OF FIRE IN A WATER GAS SET.

Written for the Twenty-sixth Annual Meeting of the American Gas Light Association by J. M. Rusby, Jersey City, N. J.

In addition to a brief general consideration of the subject of this paper, a few special tests, analyses, etc., have been made to settle certain points touched upon. These tests were made in conjunction with our regular daily operation. Our results having been much affected by some of them while in progress, they were necessarily short and irregular and were not in every respect successful. Certain facts are clearly brought out by them however.

These tests were made upon a standard double superheater Lowe Water Gas Setting. The oil used was naphtha; coal, anthracite, "broken" size. Size of set, 5 ft. internal diameter. All steam supplied to generator was generated in a separate boiler and water carefully weighed.

The conditions, results, etc., for the first set of tests are as follows: Depth of fire, 7 ft. Length of run and blow, 7 minutes each. Up and down runs in equal proportion. Power consumed in blasting, 24 I. H. P. Blast "head" on fire, 7 to 8 inches water pressure. Cleanings every 12 hours. Average gas (corrected) made per run 8450 c. ft. Steam consumed in generator per M c. ft. of gas made, 32 lbs. Generator fuel results good. Heats in carburetter and superheater good. Oil results very good. Results very uniform on all tests.

For the second set of tests the conditions, results, etc , are as follows: Depth of fire, 3 ft. Length of run and blow, 7 minutes each. Up and down runs in equal proportion. Blast "head" on fire, 4 to 6 in. Power consumed in blasting, from 8 to 14 I. H. P. Cleaning every 7 hours. Gas made per run, 5200 to 5700 c. ft. Steam consumed in generator, per M, 45 to 51 lbs. Gross generator fuel charged per M, 16% greater, and net generator fuel (gross less ash, etc., recovered) about 6% greater, than in above set of tests. Heats in carburetter and superheater very fair. Oil results good, but slightly inferior to those on preceding tests.

In the third set of tests the depth of fire was 3 ft. Length of run, 7 minutes. Length of blow varied, on the different tests, from 7 minutes to 3 minutes. Up and down runs in equal proportion. Blast "head" on fires averaged about 5½ inches. Cleaning about every 7 hours. Gas made per hour, only about one-half what it had been with 7 ft. fire. Steam supply to generator in these tests was reduced to a little more than half of the rate per minute at which it was supplied in the two foregoing sets of tests; the amount consumed per M. feet of gas ranged from about 40 to 55 lbs. Gross generator fuel charged per M almost exactly the same, and net amount about 10% lower, than in above first set of tests. The best fuel results were obtained, as might, I think, be expected, with the shortest blows, the temperature of generator fire being kept lowest. The heats in carburetter and superheater were difficult to control and were generally dull. Oil results very bad.

A number of analyses of blast gas were made during the progress of tests. Holes were drilled through the side of the generator at different heights above the grate, and through these perforated iron tubes were thrust horizontally, gas being thus colleeted from all parts of the fire. In nearly every case, even with heaviest blast employed, no oxygen could be found even 2 ft. above the grate, its combustion being complete at that point. As the temperature of fire rose, during the process of blasting, the conversion of carbonic acid into carbonic oxide was almost coincident with combustion; with a 7-minute blow, even at 2 ft. above the grate, the carbonic acid which, during the first minute of blow was 16% to 17.5%, would drop during the last minute of blow to from 7% to 10%. The temperature of the fire was, of course, very high at from 2 to 3 ft. above grate, diminishing toward the top of fire. As might be expected, the conversion of acid to oxide was increased, other circumstances being the same, by increase in depth of fire, the percentage of oxide continually increasing toward the top of a 7-ft. fire; owing to the low temperature of the top part of fire, however, this increase was small, the chief conversion taking place in the hot belt 2 to 3 ft. above the grate. The effect, on formation of oxide, of prolonged contact of blast gas with fuel bed was very plainly shown by suddenly partially closing the blast valve at any moment until the flow of blast gas was about one-half its regular rate; the percentage of oxide would increase, in every case, by 8% or 10%, samples being taken at a point 5 ft. above the grate. The conver-

sion of acid into oxide can be controlled by shortening the blow; with a 7-ft. fire and a 7-minute blow, the acid ranged anywhere within the limits of 17% and 7 or 8%; with a 3-minute blow, it seemed capable of being confined within the limits of 16% and 11% to 12%. The percentage of carbonic acid is lower by 2% or 3% after a down run than after an up run, this additional conversion to oxide being caused by the hotter fire after down run.

A few analyses of water gas were also made It was expected that because the fire was hottest at the bottom, and an excess of steam is admitted to the fire, the percentage of carbonic acid in the gas would be lowest at the bottom of a 7 ft. fire, and would also be lower, at least at the beginning of run with a shallow than a deep fire. In the few analyses made, neither supposition was found true, although differences were not great. The carbonic acid in the uncarburetted gas would increase by from 2% to 2½% from the beginning to the end of a 7-minute run. It was decreased quite materially by a shortening of blow and decreasing of steam supply.

The following is a brief discussion of the above data:

It is to be borne in mind that in the making of a plain water gas, and the making of a carburetted gas, as with the Lowe Apparatus, the objects are very different. In the former the object is to store in the fire all heat possible. In the second, a certain amount of heat must be stored in the fixing vessels for the gasification of the oil and this heat may be either the sensible heat of the products of combustion, or that produced by the burning of carbonic oxide formed in the generator; this absorption of heat is a process requiring time.

Comparing the first and second set of tests described above, we find a very greatly increased capacity per minute and run as the result of increasing the depth of fire from 3 ft to 7 ft. Although no actual measurement of quantity of air was made, I am positive, from the blast "heads" on the respective fires, that the air admitted to the shallow fire was at least as great as to the deeper one. Consequently, and in view of the fact that combustion was in all cases complete within 3 ft. of the grate, the increased amount of gas made per minute and per run must be due to the absorption of the sensible heat of the blast gas by the upper 4 ft. of fire. This increased capacity does not, of course, mean a corresponding increase in economy of fuel, for simultaneously with this absorption

of heat much carbon is carried away from the fire by the carbonic oxide formed. The fact remains that the upper portion of fire served greatly to store heat during blast giving it out again during run to make water gas, and also raise its temperature, the latter assisting the carburetter and superheater in the work of vaporizing the oil and making this process much more regular and easily controlled. An unquestionable advantage of a shallow fire (or its equivalent, a specially blasted deep fire) is a large saving of power in blasting, and the reduction of size, cost and speed of blowing machinery. The saving in cost of machinery will be largely offset, however, by the increased cost of larger or specially designed generating vessel which shall give the same capacity per minute as the deep fire apparatus. If an enlarged generator of the Lowe type be used, it is almost certain that the steam consumed in generator will be considerably greater than with deep fire, this tending to offset the economy of a steam used in blowing engine. It is also a question whether it would be possible to blast the shallow fire so as to satisfactorily heat the fixing vessels, with any considerable economy of generator fuel.

The quality of fuel used, coarse or fine, will largely affect the depth of fuel bed which will best be used. I believe that with the kind of fuel used in our case, a fire of moderate depth 5 to 6 ft. combined with short blow, will give the best result in all respects.

CAN WE MAKE ALL OUR BUSINESS PAY?

Written for the Twenty-sixth Annual Meeting of the American Gas Light Association, by Alfred E. Forstall, Montclair, N. J.

In the early days of the gas business, little attention was paid either to reducing the cost of manufacture or to developing the business. Later great stress was laid upon the necessity for economizing as much as possible at the works and bringing the cost in holder to the lowest practical point, but the sales department was still apathetic. Only during the last decade has this department awakened to the fact that in the gas business, as in all others, the only way to sell any large amount of goods and keep ahead of competitors is to advertise your wares, seeking possible purchasers to present to them the advantages of your goods and demonstrate to them the benefits to be derived from patronizing you. In the present condition of the industry there can hardly be any doubt that of equal amounts of energy applied in a well-equipped plant respectively to the decrease of cost of gas in the holder or the increase of amount sold, that given to the latter purpose will yield the larger returns in increased profits.

But in striving after new business we may lose sight of other points connected with the sales department that would repay consideration. Is it not possible that we are doing business that is not profitable, in fact is not every company doing some business at an actual loss? And cannot a way be found to make this business profitable?

In an article entitled *"Both Sides of the Ledger," Mr. N. H. Humphrys of Salisbury, England, emphasizes the necessity of a careful examination of all the circumstances connected with each class of consumers to determine its desirability and the extent to

*Journal of Gas Lighting, etc., Vol. LXXI, pages 22 and 75.

which it should be encouraged and also to settle the question of what concession in price, if any, can be fairly granted for such encouragement. He notes the various factors affecting cost of service, such as the constant or intermittent nature of the demand for gas, the relation of time of maximum consumption to the peak of the load which determines whether the particular business under consideration increases or diminishes the "load factor," the proportion between size of meter required and total amount of gas consumed in a year, and other more obscure factors to which it is hard to assign definite values. But though calling attention to the necessity of care to avoid unprofitable business, he gives no advice as to the way in which business that is shown to be unprofitable by an examination based on his line of thought, can be made profitable.

A key to the solution of the problem is given, however, by Mr. Walton Clark in the paper *"Meter Rents; A Question of Equity and Policy," read before this Association in 1891. In that paper the point is made that gas companies being granted certain rights having their origin in the citizens of the state, these rights involved obligations to the public granting them, one of which is to make no distinction in their treatment of individuals served by them. In other words, no gas company is entitled to "collect upon the investment necessary to the service of one customer an interest greater or less than is paid by any other customer upon the investment made in his behalf." Decisions of various cases in the U. S. Circuit Courts are cited as showing plainly that the profit made by corporations organized to do a public work must not be variable per unit of service rendered. From these premises Mr. Clark reasons that the equitable way of charging for the service furnished by a gas company is "to charge for each 1000 cub. ft. of gas an amount covering its proportion of the items of expense and interest common to the performance of the total service, adding to each bill so made the items peculiar to the individual service." The first portion of the charge should include the cost of supplying up to the inlet of the service pipe, including the amount per 1000 cub. ft. necessary for the payment of interest and dividends, and the second should be made up of the average cost of keeping the accounts, collecting the bills and attending to complaints, plus the interest

*Proceedings American Gas Light Association, etc., Vol. IX, page 517.

and maintenance charges for the meter and service pipe employed for the particular consumer under consideration. Mr. Clark thought that while a change from the present method of charging so much per 1000 cub. ft., with various discounts for amounts above the average, to the method he advocated, would at first lead to friction with the consumers, in the end the easily demonstrable justice of the new method would ensure an increase of popularity to the company adopting it.

At the time of its reading, this paper did not receive the attention it merited. Questions of business method had not then assumed the importance that has since been accorded them, and did not command the consideration given to problems arising on the technical side of the industry. But its arguments were strong and have lost none of their strength in the interval that has elapsed. Being a new comer into the field of office work the number of small consumers served at a direct loss to the company probably made more impression upon the writer than would have been the case had he grown up at the desk. Be this as it may, he was so much impressed that the subject of either doing away altogether with such consumers, or devising some method to make them profitable, has occupied a large share of his attention, and the more thought was put upon it the more it seemed advisable to follow the plan worked out by Mr. Clark, and to a certain extent applied by the electric companies in their system of minimum charges, and charge a certain amount for cost of service irrespective of the quantity of gas used.

In order to see how the change would affect our consumers, an analysis of the expenses was made, and the cost per consumer of keeping the accounts, collecting the bills, attending to complaints, etc., was determined. The meters were also listed by sizes and amounts registered in 1897. That is so many 3-lt. meters under 1000 cub. ft., so many between 1000 and 2000 cub. ft., and so on. For the purpose of this investigation it was not deemed necessary to take up each length of service but only to take the average cost of maintenance. And the services having all been paid for by the consumers, no interest on their cost was figured, maintenance only being considered. In the absence of definite figures for the cost of such maintenance, it was assumed at 30 cents per year per average service of 60 feet in length. Interest, depreciation and repairs on meters was figured at 15% on first cost. Working out

the charges on this basis, and taking all the figures in round numbers, it was found that the costs of service were as follows:

3-Lt. Meter,	$2.25 per year.	20-Lt. Meter,	$3.30 per year.
5-Lt. "	2.50 " "	30-Lt. "	3.80 " "
10-Lt. "	2.90 " "	45-Lt. "	4 90 " "
		60-Lt. Meter,	$6.20 per year.

Fixed charges of these amounts made upon the respective consumers, would bring in a sum of money sufficient to enable us to reduce the price of gas 12 cents per 1000 cub. ft., and still net the same profit. Making this reduction in the price of gas, and adding the charges, would cause all consumers of less than 19,000 cub. ft. per year, through a 3-lt. meter, to pay more for their gas than at present, while those consuming more than that amount would pay less. For a 5-lt. meter, the dividing line would be at 21,000 cub. ft. per year; for a 10-lt., at 24,000 cub. ft.; for a 20-lt., at 28,000 cub. ft; for a 30-lt., at 32,000 cub. ft., etc. With our conditions, the change would result in 63% of our consumers paying more for gas than they do at present, and in 37% paying less. In the case of the 6½% of meters that are passing from 100 cub. ft to 3000 cub. ft. per year, the increase in price might be so great, when figured per 1000 cub. ft., as to cause the closing of the accounts, but, as this business is now done at less than the actual cost of doing it, its loss would not be a source of any regret. However, even among this class there are some meters that would be retained, as the additional charge of $2.00 or so per year would be paid for the privilege of having gas to fall back upon in case of a failure in the electric light service. But, in most cases, the increase would be so small that it would hardly be noticed. Our figures show that of the 63% of consumers paying more, only 27% would pay over 10 cents per 1000 cub. ft., or $1.00 per year additional for the same amount of gas, a difference that would not attract any attention.

On the other hand, the larger consumers would individually derive a much greater benefit, since the loss of 63 is gained by 37. The largest consumer, through a 3-lt meter, who burnt 79,000 cub. ft., would save $7.23 by the change, and the largest consumer, through a 5 lt. meter, burning 129,000 cub. ft., would save $12.98 per year.

While an increase of price to 63% of the consumers might at first sight seem very poor policy, if the change of method were

made, as Mr. Clark suggests, simultaneously with a reduction of price independent of that due to the change, it could certainly be so arranged that there would be no actual increase except to the 6½% of consumers above noted who are burning little or no gas, but merely retain the meter as a convenience. There certainly can be no question as to the greater equity of the plan proposed compared to that now in vogue, and there does not seem to be any legal obstacle in the way of its adoption, except possibly in the case of those companies operating under franchises, municipal or otherwise, limiting closely the price to be charged per 1000 cub. ft. It would not be possible to apply a fixed charge without making the cost per 1000 cub. ft. to some consumers greater than the price fixed by law, and this might prevent its adoption in such cases. But the majority of companies are not bound in this way. They are free to arrange their charges in any way that is just and reasonable. Can there be any way more just and reasonable?

Apart from theoretical arguments have we not a very practical one in the custom of electric light companies? The company that controls the supply of electricity in our part of New Jersey will not install a meter unless the would-be consumer signs an agreement to pay at least $1.00 per month, even though, as may frequently happen in summer, no current is used during the month. They get business and are apparently making money. It would seem as if a charge of this kind that appears to make the customer pay for something that he is not getting, would be more objectionable than a charge for cost of service that is being rendered. And what is sauce for the electric goose should serve as well for the gas gander.

If, then, the proposed system of dividing the charge for gas into the two items of cost per 1000 cub. ft. for expenses that are common to all consumers, and not dependent upon the number, and fixed charge for expenses that are peculiar to the individual consumer, and independent of the quantity consumed, is more equitable than the present plan of a single item of so much per 1000 cub. ft., combining both general and special expenses in a common average price under which no two consumers pay the same amount for equivalent service, and the change, if properly timed, can be made without detriment to the popularity of the company, what argument can there be against its adoption? And if, as would seem to its advocates, the change would increase the popularity of

the company, while making all its business equally profitable, instead of this being done partly at an actual loss, partly at a small profit, and partly at an excessive profit to balance the losses, there would seem to be very strong arguments in its favor.

The method outlined is not perfect. Among other things it does not recognize the difference between a certain consumption at a time of light load, as during the day in summer, and the same consumption at a time of heavy load, as in the evening in winter, though the former can certainly be supplied more cheaply than the latter. This can be met by differences in the charge per 1000 cub. ft. for gas used at the different times, the fixed charges remaining the same, and separate meters being installed, or it can be ignored as is the case with many companies at present. But though it does not cover all factors affecting cost of service, the proposed method of charging does away with all differences between users of gas for the same purposes, and substitutes for present arbitrary extra discounts to large consumers, a perfectly fair and equitable premium to those who keep their meters working up to nearly full capacity. And it is again presented as an advance upon the crude method of charging which originated during the "dark ages" of the industry, with the idea that the present writing may supplement the original presentation, and in connection with it persuade us all to enter and follow the path of "Equity and Policy."

HOW CAN WE MAKE THE USE OF GAS FOR COOKING MORE UNIVERSAL?

WRITTEN FOR THE TWENTY-SIXTH ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION BY HENRY L. DOHERTY, MADISON, WIS.

We are all anxious to extend the use of gas for cooking both by putting out more stoves and by inducing present consumers to use gas for this purpose to the exclusion of all other fuels, regardless of seasons. I will treat this subject from the negative side, and as a basis of argument, will state in the order of importance the reasons why I assume the use of gas is not more general for this purpose during the summer season.

First.—Lack of appreciation on the part of the public of the real merits of gas for cooking.

Second.—General belief that it is more expensive than it really is.

Third.—Procrastination.

Fourth.—Cost of making installation.

Fifth.—The use of incomplete and unsatisfactory gas stoves.

Sixth.—Fear of a gas stove.

Seventh.—Dislike to abandon the use of a good coal, wood or gasoline stove.

Eighth.—Our present inability to provide consumers with hot water for bathing and other purposes at a moderate cost, and in a satisfactory manner.

Ninth.—The difficulty in disposing of garbage.

The reasons why I assume gas is not used for the entire year are, in the order of their importance, as follows:

(*a.*)—The failure of our consumers to see any advantage in the use of gas except during the heated season.

(*b.*)—No provision for heating kitchen except by cook stove.

(*c.*)—The greater relative economy in use of coal or wood at times when heat must be provided for the kitchen.

Any other reasons for not using gas during the winter are embraced in those enumerated as applying to the use of stoves in summer.

REASON No. 1.—(Lack of appreciation on the part of the public of the real merits of gas for cooking.)—

It is quite apparent that many people regard a gas stove as a toy, and fail to appreciate that it will not only cook as well as any other stove, but will do its work much better and quicker. Many people do not quickly make friends with new appliances, and evidence is so plenty in support of this statement that argument is superfluous. Advertising, soliciting and demonstrating, I believe, will most readily enable us to convince the public of the merits of gas stoves. How to advertise, solicit and demonstrate will be treated under another head.

REASON No. 2.—(General belief that it is more expensive than it really is.)—

There is a general belief that gas for cooking is extremely expensive. This is not surprising when you know that many of your customers are criminally careless, and it is also a peculiar fact that these women evidently pride themselves on the magnitude of their gas bills. Instead of remaining at home and taking care of their house. they spend their time gossiping with neighbors or friends, and are always sure to state that their gas bill for cooking comes to between four and five dollars, whereas, if they would tell the truth, they would be compelled to admit that their highest bill was $4.05, and their average bill less than $2.50. Women seem prone to exaggerate, and they seem particularly anxious to exaggerate their gas bills, feeling that this is another way to tantalize their more frugal neighbors. They seem to forget that in the eyes of some they are simply advertising their own carelessness.

Half the complaints from high bills are due to carelessness, and little can be done to cut down the bills, although a communication addressed to our present consumers, asking them to be careful in quoting their bills, and to confine themselves to the exact truth, and to always give their average bill, would probably eliminate some of this gossip about high gas bills.

There are other high bills that can be cured. Some are due to careless or ignorant servants with careful mistresses, and sometimes the trouble is in the stove. Careful attention and instructions to these servants will often remedy matters. I have found the registering complaint meter a valuable aid in determining when the excessive consumption occurred, and by investigation, was easily able to determine the class of service which caused an excessive consumption of gas. Before adopting these registering meters for complaint work, we would read the meters each day, where consumers were dissatisfied, to locate time and excessive consumption.

To those who have never tried this plan I can assure them that this practice, executed by a clever man, will prove quite efficacious in many instances. I venture the statement that gas sold at $1.25 per M. for fuel purposes where the stoves and consumers are carefully watched, will develop less dissatisfied consumers than to sell gas for $1.00 per M. and pay no attention to complaints. In support of this statement, I affirm that a larger percentage of gas stoves have been abandoned in Columbus, Ohio, where natural gas is used, having 11,000 B. T. U. per ft. and costing 20 cents per M., than in Madison, Wis., where we sell ordinary mixed coal and water gas at $1.25 per M.

When several gas appliances are used, and parties are dissatisfied with their bills, it is quite an easy matter to locate the heavy consumption by putting a meter on each appliance.

Since having enjoyed the opportunity of becoming acquainted with the two meter system, I have become an advocate of this plan. Two bills do not look as large as one to the consumer, and they require very little more work than one.

The consumer knows the exact cost of each service, and can better locate the cause for any increase. The company can accurately determine results from a campaign for either illuminating or fuel consumption, and you can readily determine when a gas stove is not in use, and take measures to induce customers to again resume its use.

I believe it good policy to watch consumption on new stoves, and if an excessive bill comes in the first month, make a thorough examination of the stove re-instruct the operator, and have the meter read weekly until the bill is reduced to the proper point. If this method fails to reduce the consumption to the satisfaction of the customer, it would probably be well to change the stove.

High gas bills are often occasioned by an excessive draft, causing over-ventilation of the oven burners. When a range is connected to a flue, we generally look out for this trouble, and if suspected, we arrange the flue pipe as shown in Figure 1. This seems to effectually prevent this trouble, and often cures an oven burner from smothering, although where this trouble is met, I would recommend an arrangement as illustrated in Figure 2. One or both of these arrangements are patented by an Eastern concern, but think you need have no fear of using them, as I have resorted to their use prior to the organization of the concern that claims them as their patents.

To prevent people from quoting their highest, rather than their lowest bills, it would in many instances pay to send them a statement at the end of the year or season, showing them their monthly, aggregate and average consumption, keeping a record of these statements carefully indexed for the use of solicitor in case some lady tells of the excessive bills of 'Mrs. Gossip."

Insufficient pressure very often adds materially to the cost of operating a stove. Theoretically, high pressure will insure a more intimate mixture of gas and air, and will also increase the rapidity of flow, both tending to produce higher flame temperature, and your economy will generally increase as you increase the differential temperature between the flame and the object absorbing the heat. Decreased pressure necessarily means decreased flow, and decreased flow generally means an increased volume of gas for a given result. For instance, you can take two quarts of water in a stew pan and place it over a stove burner consuming gas at the rate of 4 feet an hour; before your water reaches boiling temperature you will have consumed nearly twice the quantity of gas required to bring the water to the boiling point had gas been consumed at the rate of 12 feet an hour. Economy increases with increased rate of consumption up to a certain point, and this point is seldom exceeded provided the burner is properly designed to produce the highest possible flame temperature. Many high bills are occasioned by inadequate consumption, due to low pressure, small sized gas orifices, or by operator using gas at less than full head, under the mistaken belief that this plan is conducive to economy. The use of a meter placed on the piping to the stove directly under the observation of the operator should be the most effective method to teach the operator how to practice

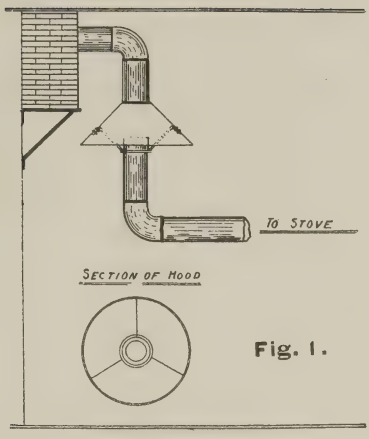


Fig. 1.

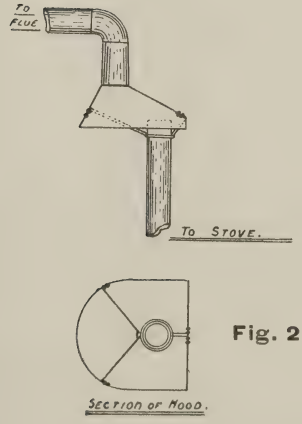


Fig. 2.

economy, and the use of a pre-payment meter at this point should insure their attention to their gas consumption. I wish the meter manufacturers would add another dial to their meters showing the consumption of 100 feet on a complete revolution, with 10 feet divisions There are many times when this dial would prove advantageous, and no reason except custom for not inaugurating the change, barring the increased expense, which would probably amount to less than 2 cents per meter. I know there are few of our friends in the meter business who cannot appreciate the advantage of this change, and I hope some of them are progressive enough to adopt it, and so announce themselves at this meeting.

If the stove men will increase the height of their ovens so they will accommodate two tiers of bread, they will enable large families to obtain more economical results, and the large families are generally the ones who have the high gas bills.

REASON No. 3 —(PROCRASTINATION.) –

People will procrastinate, and you cannot overcome this fault by putting in services free, giving away gas stoves. or reducing the price of gas. Here is one of the fields where the solicitor is invaluable.

REASON No. 4.—(COST OF MAKING INSTALLATION.)—

The fact that the cost of the installation is a hindrance to the adoption of gas for fuel, does not necessarily mean that we should put in services and stoves at the gas company's expense. Most managers seem to think this the only reason, or, at least, the main reason, why the use of gas is not more universal. I have never yet seen results from the plan of free installations that would warrant this belief. The giving away of stoves. or selling them greatly below cost, I think, is a short-sighted, unbusiness-like policy, except under conditions that are seldom apparent. What we should do is to create a desire in the public for gas stoves, and they will find some way to get them. The bicycle business so thoroughly supports this assertion, that it seems hardly necessary to indulge in a lengthy argument here. Giving away gas stoves, or selling them cheap, merely puts them a little further within the reach of those who want them, but only in a measure creates a greater public appetite for them. I believe we should devote more of our energy towards creating the want, being justified in feeling that they are

more likely to supply it than to cultivate it. It is doubtful if the average gas company can afford to make free installations, and it undoubtedly breeds an undesirable idea with the consumer regarding your margin of profits, and as most articles are valued by their cost, you can hardly expect that your patrons will attach much value to a free service or stove, or display much patience with the stove if it temporarily fails to give satisfaction.

REASON No. 5.—(THE USE OF INCOMPLETE AND UNSATISFACTORY GAS STOVES.)—

We cannot expect gas stoves to be used continuously unless they perform satisfactory work and are sufficiently large and complete to do all the work required of any stove. In a great many cities a large portion of the users of gas for cooking have a two or three burner hot plate, which is connected up with tubing and placed on their coal range. On Mondays the coal stove must be used for washing, and this necessitates disconnecting the hot plate. On Tuesdays, the ironing must be done, and the coal stove used. On Wednesdays, the baking must be done, and for the first three days of each week, all of the cooking is done on the coal range, and, unless it is very warm for the balance of the week, the hot plate remains idle until the weather demands its use. A good gas range in good working order will probably be used continuously seven days in the week and five months in the year, and possibly for the entire year. It would seem wise to discourage the adoption of hot plates and encourage the purchase of well-built, good-sized gas ranges.

REASON No. 6.—(FEAR OF A GAS STOVE.)—

There are many people who are afraid of a gas stove. They fail to distinguish between gasoline and gas in the accidents that are reported in the daily papers. On the other hand, many of them do not understand the difference between gas and gasoline, and feel that if there is danger in the use of one, the other must also be dangerous. There are many women so nervous that the snapping of a tooth-pick will cause them to start violently. These women cannot get used to the "popping" of ordinary bunsen burners, and I believe this feature of the ordinary gas stove has retarded the magnitude of our sales more than any of us appreciate. Gas stoves should be so constructed that the burners will not pop-

when turned out, and they should also be constructed to prevent the oven door from flying open and cutting the operator's face in case of an explosion due to burners being turned on for some time prior to lighting them. If it is desired that some vent be provided to prevent wrecking the stove in case of an explosion, place this vent on the side or back, where it is not likely to strike the operator if it is forced open. These oven explosions are generally caused by turning the stove off with the stop cock on the supply pipe, rather than with the individual valves, as should be done. When the stove is again used, the main stop cock is turned on and the gas flows freely to the oven, often causing an explosion. The easiest and best way to prevent these accidents is to put no stop-cock on the supply pipe, and thus compel the operator to use the individual valves.

REASON No. 7.—(DISLIKE TO ABANDON THE USE OF A GOOD COAL, WOOD OR GASOLINE STOVE.)—

Considering expense and results, it hardly seems desirable to change gasoline stoves over for the use of gas. Where the possession of a good coal, wood or gasoline stove prevents the sale of a gas stove, it would seem the most effective way to simply make a trade of a gas stove for the prospective customer's stove.

REASON No. 8.—(OUR PRESENT INABILITY TO PROVIDE CONSUMERS WITH HOT WATER FOR BATHING AND OTHER PURPOSES AT A MODERATE COST, AND IN A SATISFACTORY MANNER.)—

The hot water question is not solved by any means. Most of the pressure heaters now on the market are crude, clumsy and ineffective. Every gas company should provide means to test water heaters, and should never be satisfied with a heater until it yields an efficiency of 75%. In other words, if the heater does not put 75% of the heating value of the gas into the water, it is inefficient. Another reason why gas companies should test heaters is for the purpose of determining what rate of consumption is the most effective on their particular gas. The rate of consumption will cause the heater to vary in efficiency from minimum to maximum, represented often by 0% to 60%. It will generally be found that heaters increase in efficiency as you increase the rate of gas consumption, and consumers should be made to understand that the most economical results will be obtained by the use of a full

head of gas. The ordinary heater in ordinary use will probably not have an efficiency much above 35%. Heaters should be so constructed that solid matter will precipitate below the burner, and they should be connected as close to the kitchen boiler as possible, using the shortest length of connection pipe and the fewest bends possible. There is little or no advantage in the water heater being made a portion of the range, and many disadvantages. The independent heaters will generally be found the most effective and advantageous.

I might say much more on pressure water heaters if space would permit, but as the solution of this problem is exactly in line of steam boiler practice, I will simply recommend that the manufacturing companies provide their designer with some good, scientific treatise on steam boiler practice, or get a good, scientific steam engineer to design a heater for them.

Instantaneous water heaters are generally far more efficient than pressure water heaters, but there are many objections to their use.

First.—They are high in first cost.

Second.—They are more troublesome and complicated to operate.

Third.—The bath-room for six months in the year is overheated and under-ventilated, and the instantaneous water heater proves undesirable by increasing this disagreeable condition.

Fourth.—They demand a large flow of gas which often affects the satisfactory working of Welsbach lights and other gas appliances fed from the same service.

Fifth.—They are more frequently out of order than any other gas fuel appliance.

Sixth.—They provide hot water only at the point where they are located.

There is one heater which I have not touched upon. It is an instantaneous water heater under pressure. While it has some of the bad points of each heater, it has practically all of the good points of either. The water passes through a long coil of brass tubing located directly above several large bunsen burners. The gas is automatically turned on whenever water is drawn from any faucet on the hot water system, and gas is lighted by a small pilot jet, which is constantly burning While the tubing is but about ½ inch in diameter, there is no tendency for it to clog, as the water will not rapidly precipitate its mineral matter except when heated,

and as the water in this heater is flowing rapidly through the coil as long as it is subjected to the heat of the burners, the mineral matter is given no opportunity to precipitate.

Much better results can be obtained in heating water, no matter what kind of a heater is used, if a supplementary water storage tank is provided as explained in Mr. Clark's wrinkle furnished for 1897 meeting of Western Gas Association. Another marked economy may be practiced by reducing the loss by radiation from the kitchen boiler and piping, by shortening the conduction pipes as much as possible, and covering both the boiler and piping with heat insulating material.

REASON No. 9.—(THE DIFFICULTY OF DISPOSING OF GARBAGE.)—

The users of gas stoves have no way to burn up their garbage, and unless they are provided with means for its disposal, it is a drawback to the use of gas for cooking. After calling attention to this matter, little else can be said. Local conditions will determine the probable course to pursue to care for this objection. One manager of a gas plant has determined to operate a garbage system for his customers, if he cannot induce the city to do it for every one.

Discussion of reasons why I assume gas is not used for the entire year, viz.:

(*a.*)—The failure of our consumers to see any advantage in the use of gas except during the heated season.

(*b.*)—No provision for heating kitchen except by cook stove.

(*c.*)—The greater relative economy in use of coal or wood at times when heat must be provided for the kitchen.

The use of gas continuously for twelve months in the year is certainly desirable. The twelve months' stove will use more than twice as much gas as the summer stove. Consumers are not apt to use their stoves except in the summer unless they are provided with satisfactory means of heating their kitchen and water for baths, etc., and they are not generally apt to provide means to heat their kitchen and bath water without an earnest effort on our part. Where possible, the extension of the existing house heating system so it will embrace the kitchen, will overcome the greatest objection to the use of gas during the winter. If the houses are

heated with steam or hot water, the bath water can be easily heated by inserting a coil in the kitchen boiler, or by putting in a kitchen boiler with an interior heating coil, which is obtainable from any plumber's supply house.

If hot air is used, a coil can be put in the furnace, and the hot water obtained in this manner, and if the hot air pipes cannot be extended to the kitchen, it is also possible to heat the kitchen in this manner. It would seem a good policy for the gas companies to keep track of all the new buildings by making regular visits to the architects' offices, and it would probably pay to give the architects a premium for every house which is built or remodeled, and means provided for heating the kitchen. There are many ways to induce customers to extend their heating systems so as to embrace the kitchen. In the small cities, it would probably be necessary for the gas company to take this up direct with the consumers, but in the larger cities it will probably prove more effective to merely pay a moderate premium to architects, furnace men and steam fitters for all houses where they provide to heat kitchens from regular house heating system. In Madison, Wis., we attempted to keep our stoves in use during the winter months by inducing consumers to purchase small heating stoves for use in the kitchen. While we gained some consumption by this plan, it could hardly be pronounced a success. The cost of the fuel necessary to heat the kitchen is too noticeable, and the cook still has the annoyance of attending to a coal stove.

To sum up, I believe, the most important factors in ultimately obtaining the largest output of gas for culinary purposes, are, in the order of their importance, viz: first, making every gas stove now in use yield satisfactory results to user; second, active and intelligent solicitation to introduce stoves in homes where not used; third, persistent and intelligent advertising.

In regard to advertising and soliciting, while any effort in this line will probably prove productive, yet, I believe there is only one right way to solicit and advertise. As the two methods are both intended to accomplish the same purpose, they are both subject to the same general arguments. Soliciting and demonstrating in a general classification would be considered as a form of advertising.

Considering advertising in its strict sense, the following rules might be laid down.

Advertise incessantly in every conceivable way that seems to promise a good return on the outlay. Newspaper advertising is probably the best, and it offers an excellent means for valuing the worth of other forms of advertising. I have often used the following formula to determine the worth of other mediums of advertising compared with cost for newspaper advertising:

Number of issues × circulation × number of readers of each paper × number of units of space = the number of opportunities, and by dividing cost per number of opportunities, you have the cost per opportunity. You must then judge the comparative worth against the comparative cost of each opportunity, considering among many other factors the following, viz: the standing imparted by the medium, the desirability of class of people amongst which it circulates, and the likelihood of its being read. To reach the general classes, you will generally find that newspaper advertising is by far the most reliable and cheapest, and for many reasons the most desirable. Advertising by circulars and hand bills is of doubtful value. There is nothing that will so quickly and thoroughly offend some people as to find a hand bill thrown on their lawn, front door steps or public hall, and it is not to be wondered at. Advertising by mail, either circulars or personal letters, reaches directly the people you are after, but too much of it will prove offensive. Newspaper advertising does not offend, it is quick and reliable, and produces a friendly feeling between the newspaper and the company, that alone is often worth more than it costs. Writing the advertising matter is not an easy task. The advertising agent for any other business can talk about some other commodity every day. The dry goods man, for instance, can talk towels, handkerchiefs, dress goods and a hundred other things. You must talk the same thing every day—365 days in the year. Your "ads" must be fresh and bright, or they will not be read, and they must not be flippant or they will fail to create the desired effect.

In a city under fair conditions where advertising is properly done, both in quantity and quality, the opportunities will probably support one solicitor for every 5000 inhabitants. To intelligently direct their efforts, you must divide the city into districts and ascertain the number of houses, who occupies them, who owns them, and much other information. You then know the total number of possibilities, and can judge the comparative merits of

your solicitors. A poor solicitor often does more harm than good, —a good solicitor is beyond description. He can sell stoves where you could not give them away, even if you furnished free gas. He can overcome apparent insurmountable obstacles. He can acquire the friendship of numerous people, and command their influence and assistance. You thus have many agents while you pay the salary of but one. Your solicitors give you an excellent avenue through which to feel the public's pulse.

Demonstrations in cooking in the ordinary manner are effective as far as they reach, but you can give free demonstrations for a year, and a careful investigation will reveal the fact that the attendance has been limited to a very small fraction of the people you wish to reach. If you want to reach a large portion, you will probably find it necessary to borrow your consumer's kitchens, and have your solicitor get the neighboring women to come in and witness the demonstration. You will probably find this by far the most effective method, as you have but a few in attendance. They are the very ones you want, and your solicitor and demonstrator have an excellent opportunity for individual work.

I have taken some pains to treat this subject in a manner applicable to cities of all sizes, and to prevent offending any one feeling inclined to pompously toss my paper aside as being applicable to villages only, I wish to have my position definitely understood by stating my belief. We must make our work more individual in character, as general work is less effective. A large city is capable of being divided into whatever sized communities can be most advantageously treated, and work lacking thoroughness cannot much longer be excused on account of the size of the city.

THE LOSS OF ILLUMINATING POWER OF 25 TO 30 CANDLE-GAS WHEN MIXED WITH AIR.

WRITTEN FOR THE TWENTY-SIXTH ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION BY DR. E. G. LOVE, OF NEW YORK, N. Y.

In 1862 Audouin and Bérard published in *Annales de Chimie et de Physique* the results of some experiments on the effect upon the illuminating power of gas of various admixtures of air. This table in a greatly abridged form has been frequently referred to by writers for the past 35 years, usually without any mention or even knowledge of its origin, or the conditions under which the tests were made. These experimenters used the low quality coal-gas of Paris, and as they were studying a problem in street lighting they burned it in a bat's-wing burner at the rate of 140 litres (4.94 cu. ft.) per hour. They found that 1% of air reduced the illuminating power 6%, 2% of air reduced it 11%, 3% of air reduced it 18%, and so on. The percentage of loss for each per cent. of air varied considerably according to the quantity of air in the mixture. Thus, the first per cent. reduced the illuminating power 6%, but in a mixture containing 7% of air this had increased to 7.57%, while in a 40% mixture each per cent. had a deleterious effect of only 2.47%. Mr R. H. Patterson, in commenting on these results in 1880, and without any knowledge of their authorship except that they had been quoted by Dr. Letheby, expressed some doubts as to the correctness of the figures, as it did not seem to him probable that the first 10% of air added should reduce the light by 67%, while the fourth 10% reduced it only 2%.

In 1878 Mr. H. Aitken published some results on mixtures of air with gas of 27.8 candle power — probably a cannel gas. No mention is made of the burner used, but judging from the quality of the gas we should infer it was a flat-flame, although the results obtained would indicate that an Argand was employed. His experiments included only four mixtures, containing respectively 0.5%, 1%, 5% and 10% of air, and the results show that the deleterious effect of each per cent. of air in these mixtures was 4.82, 4.42, 2.94, and 2.52%.

Some figures were published by Mr. B. W. Smith in 1885, showing the effect of air on 16.6 candle coal-gas consumed in an Argand

burner. The mixtures employed contained from 0.25% to 3% of air, and the results show a fairly constant effect for each per cent. of air in the mixture, being 3.6% for a ¼% mixture, and varying from 4.2% to 4.62% for mixtures containing from 0.5% to 3% of air.

Dr. Schilling and Inspector Ries made some experiments in this direction in 1891, in which a coal gas of 19 candle power was used, and the tests were made with a slit-burner. The mixtures contained 2, 4, 6, and 8% of air respectively, and the deleterious effect on the illuminating power of each per cent. was found to be 7.25, 6.70, 6.27, and 6.02%.

It may be of interest in this connection to mention the experiments by Dr. P. F. Frankland in 1884, on mixtures of ethylene and air. He tested six mixtures in which the air varied from 20.32 to 77.69%. In mixtures containing up to about 40% of air, the percentage of loss corresponded with the percentage of air in the mixture; but from this point the air had a slightly increasing deleterious effect.

For convenience I have placed in the following table the results with coal-gas just referred to, and I think you will admit that the record is rather confusing.

Percentage of Air in Mixture.	Audouin and Bérard, 1862. 12–14 Candle Gas. Flat Flame Burner.		H. Aitken, 1878. 27.8 Candle Gas.		B. W. Smith, 1885, 16.6 Candle Gas. Argand Burner.		Schilling and Ries, 1891. 19 Candle Gas. Flat Flame Burner.	
	Loss %	Loss % for 1% Air.	Loss %	Loss % for 1% Air.	Loss %	Loss % for 1% Air.	Loss %	Loss % for 1% Air.
0.25					0.90	3.60		
0.50			2.41	4.82	2.10	4.20		
0.75					3.31	4 41		
1.00	6	6.0	4.42	4.42	4.51	4 51		
1.25					5.40	4.32		
1.50					6.62	4.41		
2.00	11	5.5			9.03	4.51	14 5	7.25
3.00	18	6.0			13.85	4.62		
4.00	26	6.5					26.8	6.70
5.00	33	6.6	14.70	2.94				
6.00	44	7.33					37.6	6.27
7.00	53	7.57						
8.00	58	7 25					48.2	6.02
9.00	64	7 11						
10.00	67	6.7	25.23	2.52				
15.00	80	5.33						
20.00	93	4.65						
30.00	98	3.26						
40.00	99	2.47						
45.00	100							

The work of Audouin and Bérard in this line was but a small part of an investigation on gas burners carried out under the direction of Dumas and Regnault, and for this reason, if for no other, is, I think, entitled to great weight.

It would be foreign to the purpose of this paper to enter into any extended examination of the results obtained on the deleterious action of air on coal-gas, but there are one or two points to which I wish to call your attention.

It is generally understood that an illuminating gas of low quality suffers more by admixture with incombustible diluents than a gas of high candle power, and that in either case the injurious effect is much greater with flat-flame burners than with Argands.

If we assume that the figures reported by Aitken were obtained with an Argand, and we compare them with those obtained by Smith, we see that the deleterious effect of 1% of air is practically the same with gas of 17 candle-power as with one of 28 candle-power. On the other hand if they were obtained with a flat-flame burner is it probable that the effect is so much less with a 28 candle gas than with a 14 or 19 candle gas, as shown by the tests of Audouin and Bérard, and of Schilling.

Moreover, it is a matter of surprise that in the Aitken experiments the effect of 1% of air in a 10% mixture should be only 2.52% while it was 4.42% in a 1% mixture.

Does the injurious effect of 1% of air in mixtures containing from 2% to 8% increase as shown by Audouin and Bérard, or decrease as shown by Schilling. In a word, what is the effect upon the candle-power of a coal-gas of the addition of various proportions of air when the mixtures are tested in the consumer's flat-flame burner.

It may be possible to reconcile to some extent the results given in the table, but it seems to us that if this is done it must be by a more careful and extended study of the effect of air upon the different hydrocarbons which contribute light to the flame.

So far as we are aware no experiments have been made to determine the effect of air upon the illuminating power of water-gas, especially that of 25 to 30 candle-power; and we therefore offer the following results as a small contribution in this direction.

The tests here recorded were made in five series, each of which included a number of mixtures covering a wide range in the percentages of air and gas. Where mixtures in different series were

found to have practically the same composition, the results obtained with such mixtures were averaged.

The illuminating power of the gas used in the different series was 26.36, 26.50, 26.48, 25.86, and 25.30 at 60° F. and 30 in. pressure, tested by the Bray Slit-Union No. 7. This burner was also used in testing the the air-gas mixtures; and the consumption was in all cases regulated to 5 cu. ft. per hour.

The mixtures of air and gas were made by measure, but these were checked by analyses of the mixtures, samples of which were taken in tubes placed just before the burner.

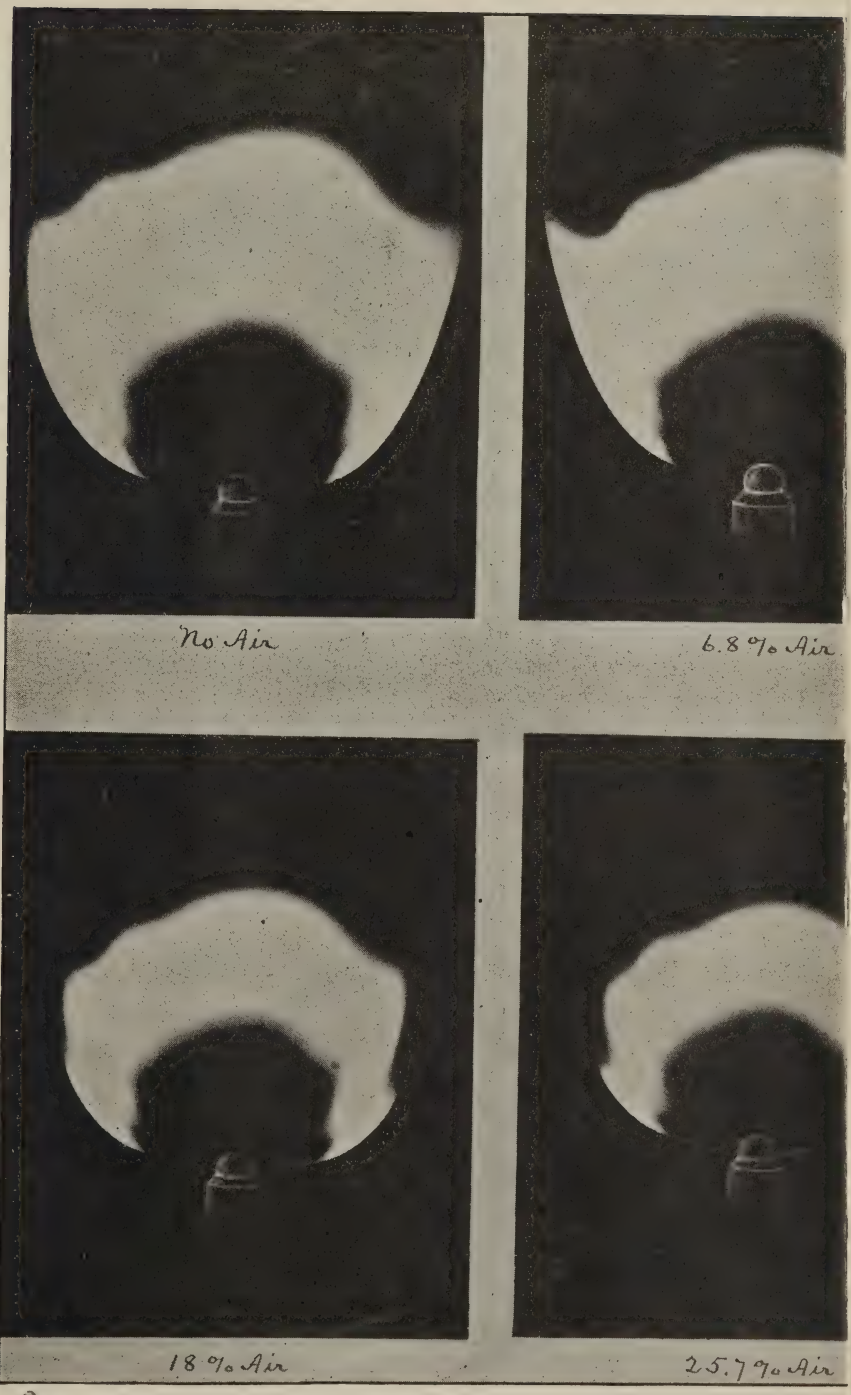
No attempt was made to test mixtures containing very small percentages of air, the lowest being 2.82%, and increasing from this to 40.8%, at which point the loss of illuminating power was 93.8%.

The following table gives the results obtained:

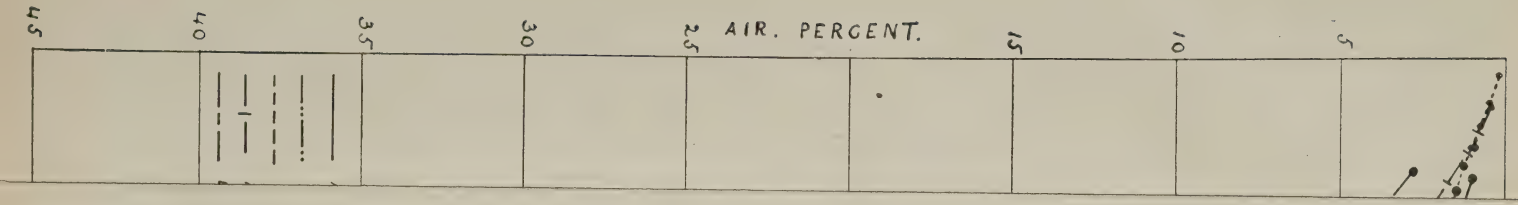
Percentage of Air in Mixture.	Loss of Illuminating Power. Per cent.	Loss of Illuminating Power for 1% of Air. Per cent.	Percentage of Air in Mixture.	Loss of Illuminating Power. Per cent.	Loss of Illuminating Power for 1% of Air. Per cent.
2 82	5.72	2.03	17.65	44.30	2.51
4.94	10.08	2.04	19.84	51.19	2.58
5.40	11.24	2.08	21.56	56.69	2.63
8.51	18.04	2.12	22.22	58.88	2.65
8.95	19 06	2.13	24.16	64.51	2.67
9.62	21.16	2.20	27.69	72.82	2.63
10.40	23.24	2 24	31.30	80.44	2.57
11 20	26.66	2.38	32.95	83.36	2 53
12.35	29.02	2.35	34.53	87.02	2 52
12.81	30.48	2.38	37.50	90.37	2.41
15 25	37.66	2.47	40.79	93 82	2.30
16 98	42 28	2.49			

From this it appears that with low percentages of air the percentage of loss is a little more than twice the amount of air present in the mixture; that as the quantity of air increases, its deleterious effect increases in a somewhat higher ratio, reaching a maximum with about 25% of air, and that from this point the rate of depreciation gradually decreases until the flame has lost its illuminating power.

If these results are compared with those of Audouin and Bérard, it will be noticed that although the rate of loss is much greater in


No Air
6.8 % Air
18 % Air
25.7 % Air

No Air
6.8 % Air
11.3 % Air
18 % Air
25.7 % Air
36.0 % Air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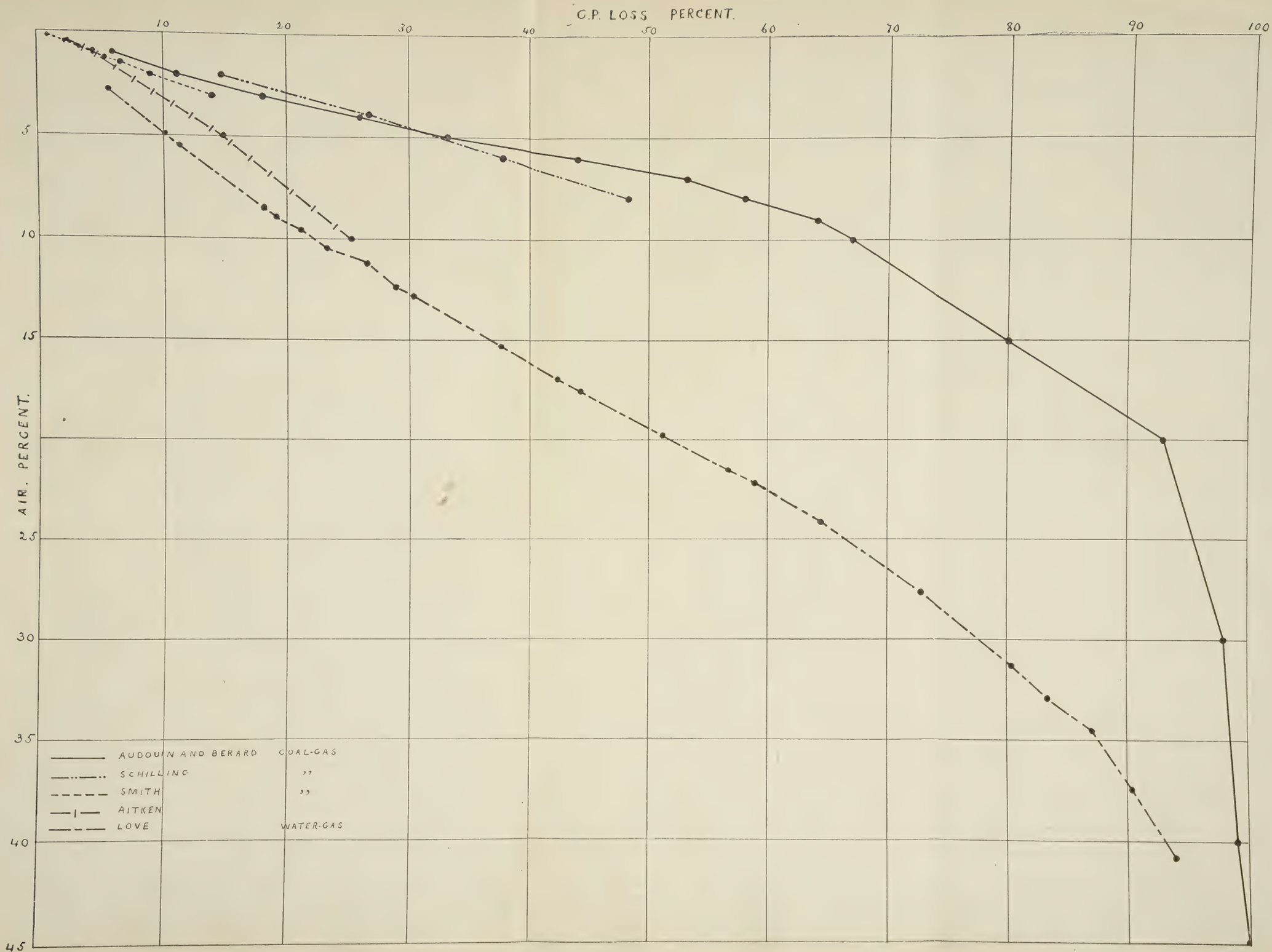
C.P. LOSS PERCENT.
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AIR. PERCENT.
AUDOUIN AND BERARD COAL-GAS
SCHILLING ,,
SMITH ,,
AITKEN
LOVE WATER-GAS

one case than in the other, the general distribution of this loss is practically the same in both cases. Owing however to the greater rate of loss in the case of coal-gas, the practical disillumination of its flame occurs with a much lower percentage of air than in the water-gas flame. Thus with a mixture containing 20% of air, coal-gas loses 93% of its illuminating power, while with a corresponding mixture water-gas loses only about one-half.

No very close comparisons can be made however between the results in the case of water-gas and those obtained by Audouin and Bérard with coal-gas, for aside from the difference in their quality the gas in the former case was burned under conditions best suited to develop its illuminating power, while the burning of a low quality coal-gas in a flat-flame burner is a very effective means of destroying its luminosity.

On the accompanying diagram I have plotted the results referred to in the case of coal-gas together with those obtained with water-gas. The ordinates indicate percentages of loss in illuminating power, and the abscissas percentages of air in the mixtures.

As regards the appearance of the flame from a mixture of air and water-gas, it may be said that with mixtures containing about 5% or less of air the eye alone is hardly able to detect any difference except with the help of a comparison flame, and even then the most noticeable change is a slight reduction in size. The addition of larger percentages of air produces very marked changes in the flame, which rapidly diminishes in size and has a dull and impoverished appearance.

The accompanying photographs, which are "life size," will give some idea of the relative sizes of flames consuming gas and different mixtures of gas and air, the consumption in each case being 5 cu. ft. per hour. As these flames were photographed "instantaneously," and by means of their own light, the blue zone appears somewhat larger than it really is, since the more feeble light from the upper portion of this zone was not able to impress the photographic plate during the time of the exposure.

Although the Argand plays no part in the official testing or practical use of rich water-gas, it was thought to be a matter of interest to know the effect of air as shown by this burner, and an effort was made to determine this, but the experiments were too few to warrant my giving any figures. It may be said, however, that the loss is very small. The presence of air is shown at once

by the appearance of the flame, and indeed it is more noticeable here than on the photometer disc. The first effect is a shortening of the flame, followed by the dissappearance of its reddish and more or less irregular tip, and a decided increase in the intensity of the brighter portion. This effect is merely intensified as the percentage of air in the mixture is increased, until with about 25% of air the height of the flame is reduced fully one half. The effect is similar to that produced by lengthening the chimney.

It is very desirable that a careful revision be made of the results so far obtained on the depreciating effect of air on coal-gas, and also that the experiments here recorded with water-gas should be repeated by other members of the Association who may be more fortunately situated than the writer for carrying on such work.

Every experiment made with care and under known conditions is of value in reaching the desired result.

A GAS ENGINE IN A BLOWING PLANT.

SHORT TOPIC WRITTEN FOR THE TWENTY-SIXTH ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION BY H. L. RICE, OF NORFOLK, VA.

In the Fall of 1897 we remodelled our blowing plant and installed a Westinghouse gas engine as our principal blowing engine. Our old Sturtevant upright steam engine became the auxiliary engine. These engines belt to the same countershaft and operate a No. 6 Sturtevant blower. The gas engine is rated at about 25 H. P. with a speed of 350, and has its speed cut down to 275 to give about 16 H. P. The steam engine is rated at 15 H. P. and appears slightly overloaded. The load is estimated at 16 H. P. For some time these engines have been running alternately and a record has been kept of their relative performance. It is this record which your committee thought might be interesting. It is not pretended that this record is scientifically accurate in the sense that a careful boiler and engine test is accurate. The gas plant was operated as usual, the engines being alternated at convenient intervals of about ten days each, and the boiler fuel determined as carefully as possible. Three of these intervals are selected for each engine during which no steam was required except in the regular operations of gas making. Periods in which the steam use was for any cause uncertain are not considered. The boiler fuel figures for these periods are as follows:

STEAM ENGINE.

	1.	2.	3.	Average.
½ Screenings per M...	4.47	4.65	5.33	
Coke per M.....	3.14	——	——	
Coal "	2.42	8.16	5.76	
Total "	10.03	12.81	11.09	11.31

GAS ENGINE.

	1.	2.	3.	Average.
½ Screenings per M...	4.79	4.80	3 41	
Coke per M.....	3.12	——	——	
Coal "	0.54	5.18	5.37	
Total "	8.45	9.98	8.78	9.07
Gas "	14.70	15.67	14.64	15.00

The figures run closer than would appear at first sight, the variations being proportional to the hours of running the plant. This factor of gas making was distributed as evenly as possible between the two engines. Reducing the above to cents per thousand with coal at $2.51 per long ton and coke at $3.05 per net ton, we have:

STEAM ENGINE.

	1.	2.	3.	Average.
½ Screenings per M...	.6839	.7105	.8155	
Coke per M	.4804	——	——	
Coal "	.2710	.9139	.6451	
Total "	1.4353	1.6244	1.4606	1.5068

GAS ENGINE.

	1.	2.	3.	
½ Screenings per M...	.7328	.7344	.8196	
Coke per M.....	.4774	——	— –	
Coal "	.0605	.5802	.3819	
Total "	1.2707	1.3146	1.2015	1.2623

This leaves for 15 cubic feet of gas .2345 cents or 16.3 cents per thousand. There is a difference of 4/100 of a cent per thousand in favor of the gas engine in oil consumption, which is, however, closely balanced by the larger consumption of water. The above figures will be more readily understood if the actual performance of the gas engine is stated. In a run of 10½ hours, making forty eight runs and blows with a gas make of 168,000, the gas engine will consume under best conditions of steady running about 2,400 cubic feet of 22 C. P. water gas. This is 14.34 cubic feet per thousand, or somewhat better than the test figures given above. The engine when not blowing is slowed down to half speed by means of a gas by-pass. It is a two cylinder engine, and runs

steadily at this lowered speed, but cannot be slowed down more without danger of stopping. It is found to consume 340 feet per hour at full speed and 170 at half speed, the gas consumption between these limits being thus proportional to the speed. The engine is blowing up about 216 minutes and running slow 414 minutes of the 10½ hours. It takes therefore 1173 cubic feet of gas merely to keep the engine running, which cuts seriously into its economy. The steam engine can be slowed down much more radically, and we have therefore a larger average H. P. with the gas engine than with steam. The gas consumption at full load is seen to be upwards of 20 feet per H. P. The engine is of the enclosed type and closely resembles in general appearance the Westinghouse steam engine. This gas engine, having two or more cylinders, is more suitable for blowing purposes than a single explosion gas engine, in that it can be slowed down. Its igniters are rather delicate and require careful attention. It runs very steadily at all speeds. In fairness to this particular engine one more feature should be considered. As above stated, it is a 25 H. P. engine with speed cut down. The Westinghouse people estimate the frictional loss at 14%. Using this figure, were the engine 16 H. P., as is the steam engine, it would consume only 316 cubic feet per hour at full speed, and its gas revenue, compared with steam, would be 18.1 cents instead of 16.3 cents per thousand.

AN EXPERIMENT WITH THE SHADBOLT SELF-ENRICHMENT PROCESS.

SHORT TOPIC WRITTEN FOR THE TWENTY-SIXTH ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION BY IRVIN BUTTERWORTH, OF COLUMBUS, OHIO.

Having been requested to do so, I will give a brief account of an experiment made at the Columbus, Ohio, gas works during the past summer with the Shadbolt self-enrichment process.

Not having been troubled with naphthaline for many years, our experiment was made solely with the view of securing, if possible, an increase in candle power.

The conditions were as follows: Coal gas only is made, our condensing and scrubbing apparatus being such that the candle power of the gas is about 17, with no enrichment whatever. We, however, enrich our gas to about 20 candles by running 63 degree naphtha into our retorts at the rate of about five gallons per ton of coal carbonized. It was with this enriched gas that our experiment was made. Candle power tests were carefully made by means of a bar photometer. Varying percentages of gas were taken from the inlet of the purifiers and returned to the exhauster inlet, the returned gas being carefully measured by means of a wet meter. The temperature of the gas at the exhauster inlet varied between 110 and 120 degrees F., while the returned gas was nearly constant at 70 degrees.

The same coal was used throughout the tests and all conditions likely to affect the candle power were kept as uniform as possible.

The first series of tests covered a period of two weeks, during which the proportion of gas returned was varied from time to time between 6% and 16% of the make. There was no decided increase in candle power at any percentage, and the fluctuations thereof were slight, irregular and contradictory, and generally attributable to other causes than the varying proportions of gas returned.

The second series of tests covered a period of one week, during which no gas whatever was returned, while frequent and careful photometric tests showed the average candle power to be 19.88.

Other conditions remaining as nearly as possible the same, exactly 10% of the gas was then returned continuously for the following week, during which the third series of tests showed the candle power to average 20.02, being an increase of .14 of a candle, or .7%.

The result was disappointing, as the increase was not deemed sufficient to pay for repumping 10% of the gas. It will be noted, however, that the experiments were by no means exhaustive, in that the returned gas was taken from one point only and returned to one point only. Had different points been tried, a combination might have been found productive of better results. It is probable, however, that self-enrichment by this method is possible only with a lean and unenriched gas of not more than 16 or 17 candle power.

Since the foregoing was written, however, a single but careful test was made at our works with the gas unenriched with naphtha, the other conditions remaining as in tests above described, except that only 8% of the gas was returned. The result was as follows

Candle power with no gas returned, 16.50
" " " 8% " " 16.65

The increase in this case also was so slight that it could easily have been due to errors of observation or other causes than the return of a portion of the gas, and we conclude that under the conditions stated the Shadbolt process is not effective at our works.

In Memoriam.

"Gain is not in added years,
Nor in death is loss."

WILLIAM L. PROCTOR,
Ogdensburg, N. Y.
Died November 17th, 1897.

JAMES F. ROGERS,
Jamaica Plains, Mass.
Died December 18th, 1897.

GEORGE D. CABOT,
Lawrence, Mass.
Died January 18th, 1898.

JOHN TRACY,
Poughkeepsie, N. Y.
Died March 19th, 1898.

CLEFFORD L. SLADE,
Yonkers, N. Y.
Died May 18th, 1898.

WILLIAM GARDNER,
Pittsburg, Pa.
Died August 5th, 1898.

"Until the Angel
Calls them, they slumber."

WILLIAM L. PROCTOR.

Born, March 26th, 1837. Died, November 17th, 1897.

William L. Proctor was born in East Washington, N. H., and remained there working upon his father's farm until twenty years of age. He then moved to Burlington, Vt., engaging in the lumber business.

In 1859 he went to Ogdensburg, N. Y., as manager of a lumber yard and planing mill, which business grew under his supervision into one of the principal industries of that town. He soon became influential in his new home, being always ready to place his shoulder to the wheel and help along anything that would conduce to its welfare. Many times elected chief executive of Ogdensburg, at the time of his death he was president of the Boards of Public Works, Town Hall Commissioners, Poor Commissioners, and Cemetery Commissioners, and was also president of the Board of Managers of the St. Lawrence State Hospital, and a manager of the City Hospital and Orphanage. In business life he was also prominent, and, including gas among his other interests, became president of the Ogdensburg Gas Co., which position he held for many years.

He was elected an active member of the Association at the meeting held in New York City October 21st, 1891.

In his death his adopted city suffered a severe loss, its appreciation of which was shown by the closing of the business houses during the time of the funeral.

JAMES F. ROGERS.

Born, July 20th, 1832. Died, December 18th, 1897.

James F. Rogers was born at Langdon, N. H., and removed to Boston when eighteen years old. Soon after he entered the service of the Boston Gas Light Company, and remained with it until shortly before the beginning of the civil war. November 4th, 1861, he enlisted in the Fifth New Hampshire Regiment and was in active service until October 1862, when wounds received in the battle of Fair Oaks caused his retirement from duty. He then took the position of Engineer and Superintendent of the Jamaica Plain

Gas Light Company, which he filled loyally and faithfully for more than a third of a century.

He was a prominent member of various Gas Associations, joining the New England Association of Gas Engineers in 1873, the American Association in October 18th, 1876, and the Guild of Gas Managers in 1881, and was a frequent attendant at the meetings of these bodies until poor health prevented his traveling. And the friendships made in this way were shown by the presence of many New England gas men at his funeral.

GEORGE D. CABOT.

Born, April 26th, 1812. Died, January 18th, 1898.

George D. Cabot was born in Jamaica Plain, Mass. On the completion of a course at the Watertown, Mass., Academy, he entered business life in the employ of Merrick, Leo & Co., who were engaged in the manufacture of cotton cloth. In this line of trade he remained until in 1845 he removed to Lawrence, Mass, and took an important position with the Essex Mills Company. About 1850 Mr. Cabot took charge of the machine shops of the Company, and as the Essex Mills Gas Works soon began to supply gas to the public of Lawrence on a fairly large scale, he was put in charge of that section of the business. The Lawrence Gas Company grew out of this enterprise, and, as its agent, Mr. Cabot led its development until in 1885 he retired to enjoy a well earned leisure.

One of the charter members of the New England Association of Gas Engineers, a member of its first Board of Directors and president during 1875-76, he was also a member and first president of the Guild of Gas Managers, and a non-resident member of the Society of Gas Lighting.

He was elected an active member of the American Association May 13th, 1874, and in all of these bodies was well and favorably known.

JOHN TRACY.

Born, February 19th, 1848. Died, March 19th, 1898.

Born at Rochester, N. Y., John Tracy was the son of Francis Tracy who was employed by the Cartwrights of Philadelphia, then

prominent constructors of gas plants along the Hudson River. Francis Tracy during the fifties took a position under Mr. Wm. Cartwright, at that time superintendent of the Poughkeepsie Gas Works. The family having thus removed to Poughkeepsie, John Tracy was educated in the public schools of that place, and in his seventeenth year apprenticed to a cutter. He mastered this trade, but not finding it to his liking, when he became of age he entered the employ of the Poughkeepsie Gas Co in a subordinate position. Later he was made Superintendent of the Fishkill-on-Hudson Gas Works, and in 1878 returned to Poughkeepsie to succeed Mr. John Cartwright in the management of the works there. He continued in charge of these until his death, his administration proving entirely satisfactory to the proprietors.

He was elected a member of the American Association at the meeting held in New York City, October 21st. 1891.

Thoroughly practical and independent, he was at the same time fully alive to the good in others, and his geniality attracted friendship, which his steadfastness and uprightness retained.

CLEFFORD L. SLADE.

BORN, May 12th, 1872. DIED, May 18th, 1898.

Clefford Leon Slade was born at Yonkers, N. Y. He was the second son of Mr. James Slade, Superintendent of the Yonkers Gas Light Co. for the past thirty years or more. Of a mechanical turn of mind, he naturally and almost involuntarily became familiar with the details of gas works management. Declining of choice a technical education after leaving the academy of the Rev. W. R. Hooper, he accepted a position in the station of the Yonkers Electric Light Co., which he held for several years. At the suggestion of his father, he entered the employ of the gas company in a subordinate position. In January, 1897, he was appointed superintendent of the Westchester Gas & Electric Co., supplying Portchester, Mamaroneck and Rye, N. Y., which position he held until the property changed hands May 1st, 1898. This was therefore his first and only charge. He gained some prominence as an amateur oarsman, being much above the average in strength and physique. He was unmarried. He was elected an active member of the American Association October 20th, 1897.

WILLIAM GARDNER.

BORN, June 22d, 1835. DIED, August 5th, 1898.

William Gardner was born at Omagh, Ireland, but when nine years old his parents emigrated to Philadelphia and there his education was completed A course of practical mechanical training fitted him for a career in gas works construction, though his first work was in connection with sugar refining plants in Cuba in the employ of the Messrs. Bartol, who later assisted largely in the development of the gas business in this country. At the end of 1859, Mr. Gardiner went to Portland, Oregon, to superintend the construction of the works of the Portland Gas Co. Upon their completion he was retained as manager until he resigned to undertake the overhauling of the works at Sacramento, Cal. In 1862 he rebuilt the works at Johnstown, Pa., and later reconstructed those at Akron and Canton, Ohio. In 1864 he established at Lockport, Pa., a factory for the manufacture of clay gas retorts blocks, etc., which he actively supervised until 1883, retiring then in favor of his son. He also did much in the line of consulting gas engineering, being especially connected with the erection, in 1893-94, of the new plant of the Altoona (Pa.) Gas Co.

Elected a member of the American Association, May 12th, 1875, he was always a loyal member.

UNITED STATES PATENTS RELATING TO GAS.

ISSUED FROM OCTOBER 1ST, 1897, TO OCTOBER 1ST, 1898.

October 5, 1897.

590,955. ACETYLENE-GAS LAMP. Charles W. Beck, Chicago, Ill. Filed Sept. 14, 1896. Serial No. 605,723.

591,036. INCANDESCENT GAS-BURNER. Moritz Eisner, New York, N. Y. Filed Apr. 2, 1897. Serial No. 630,418.

591,046. GAS-BURNER. Joseph A. Kloeb, Washington, D. C., assignor of one half to Carl J. Mess, same place. Filed Feb. 20, 1897. Serial No. 624,297.

591,071. ELECTRIC GAS-LIGHTING APPARATUS. Adrian L. Bogert, Jamaica, N. Y., assignor to William B. M. Jordan, New York, N. Y. Filed Feb. 24, 1897. Serial No. 624,852.

591,132. ACETYLENE-GAS LAMP. Henry M. Handshy, Chicago, Ill., assignor to Chester J. McPherson, same place. Filed Dec. 11, 1896. Serial No. 615,097.

591,271. GAS-MAIN STOPPER. Patrick Goodman, New York, N. Y. Filed Mar. 9, 1897. Serial No. 626,600.

591,367. ACETYLENE-GAS LAMP. Charles W. Beck, Chicago, Ill. Filed Sept. 14, 1896. Renewed Sept. 11, 1897. Serial No. 651,309.

October 12.

11,633. GAS-ENGINE AND GENERATOR. Daniel Best, San Leandro, Cal. Filed Apr. 8, 1897. Serial No. 631,331. Original No. 544,879, dated Aug. 29, 1895. (Reissue.)

591,438. MATERIAL FOR HOODS OR MANTLES FOR INCANDESCENT GAS-LIGHTS. William L. Voelker, Elizabeth, N. J., assignor to the Voelker Light Company of New Jersey. Filed Aug. 18, 1896. Serial No. 603,147.

591,514. COIN-CONTROLLED GAS-VENDING MACHINE. Wesley Webber, New York, N. Y. Filed Aug. 26, 1896. Serial No. 603,987.

591,515. COIN-CONTROLLED GAS-VENDING MACHINE. Wesley Webber, New York, N. Y. Filed Mar. 2, 1897. Serial No. 625,715.

591,598. IGNITER FOR GAS OR GASOLENE ENGINES. Milon O. Godding, Monrovia, Cal. Filed Feb. 3, 1897. Serial No. 621,903.

591,652. Incandescent Burner. Joseph B. de Léry, New York, N. Y. Filed Mar. 2, 1897. Serial No. 625,704.

October 19.

591,862. Gas-Engine. Charles L. Mayhew, Saratoga Springs, N. Y. Filed Dec. 11, 1895. Serial No. 571,781.

591,952. Explosive-Engine. Charles I. Cummings and John C. Hilton, Erie, Pa. Filed Dec. 19, 1896. Serial No. 616,274.

592,033. Explosive-Engine. Carl W. Weiss, New York, N. Y. Filed June 12, 1896. Serial No. 595,252.

592,034. Explosive-Engine. Carl W. Weiss, New York, N. Y. Filed Dec. 17, 1896. Serial No. 615,975.

592,035. Acetylene-Gas Generator. David S. Williams, Philadelphia, Pa. Filed Dec. 15, 1896. Serial No. 615,732.

592,073. Gas-Engine. Paul Auriol, Paris, France. Filed Apr. 17, 1896. Serial No. 587,950. Patented in France Sept. 19, 1895. No. 250,384.

592,083. Acetylene-Gas Generator. John C. Dupee, Chicago, Ill., assignor of one-half to Ripley J. White, same place. Filed August 29, 1896. Serial No. 604,248.

592,084. Acetylene-Gas Generator. John C. Dupee, Chicago, Ill., assignor of one-half to Ripley J. White, same place. Filed Dec. 21, 1896. Serial No. 616,392.

592,102. Gas-Generator and Burner. Orrin P. Talley, Chicago, Ill., assignor of two-thirds to Henry T. Spivey and Robert B. Spivey, same place. Filed May 19, 1897. Serial No. 637,303.

592,183. Self-Locking Gas-Fixture. Reuben S. Whittier, Revere, and John N. Landers, Boston, Mass. Filed Feb. 6, 1897. Serial No. 622,267.

592,185. Gas-Apparatus. Joseph H. Baker, Brooklyn, N. Y. Filed Oct. 5, 1896. Serial No. 607,894.

592,209. Manufacture of Incandescents. Charles G. Richardson, New Brighton, N. Y. Filed Mar. 10, 1897. Serial No. 626,844.

October 26

592,299. Burner for Acetylene Gas. Jules Lebeau, Chatelineau, and Leon Mineur, Brussels, Belgium. Filed Nov. 6, 1896. Serial No. 611,278. Patented in Belgium Mar. 25, 1896, No. 120,594, Apr. 16, 1896, No. 120,904, and Sept. 19, 1896, No. 123,584; in England, May 5, 1896, No. 9,861, and in France, July 19, 1896, No. 295,845.

592,579. Carbureter. Henry G. Balkam, Washington, D. C., assignor to William A. Easterday, same place. Filed April 20, 1897. Serial No. 633,040.

592,597. Automatic Gas Shut-Off. Charles E. Schuster, Allegheny, and William Schuster, Pittsburg, Pa. Filed Jan. 22, 1897. Serial No. 620,291.

592,605. Gas-Generator. Henry J. Burt, Liberty, Ind. Filed Aug. 19, 1896. Serial No. 603,259.

592,669. Gas-Engine. Clark Sintz, Grand Rapids, Mich. Filed Aug. 22, 1895. Serial No. 560,181.

November 2.

592,759. Apparatus for Generating Acetylene Gas. Charles H. Bellamy, South Hadley Falls, Mass. Filed Jan. 27, 1897. Serial No. 620,929.

592,794. Gas or Oil Motor Engine. Frederick W. Lanchester, Alvechurch, England. Filed July 8, 1896. Serial No. 598,480.

592,881. Igniter for Gas-Engines. Fred. C. Olin, Buffalo, N. Y., assignor to the Olin Gas-Engine Company, same place. Filed Dec 7, 1896. Serial No. 614,681.

593,034. Gas-Engine. Fred. W. Spacke, Indianapolis, Ind. Filed Apr. 7, 1896. Serial No. 586,572.

593,106. Gas-Incandescent. Oskar Knöfler, Charlottenburg, Germany. Filed Aug. 12, 1895. Serial No. 559,070.

593,122. Acetylene-Gas Generator. John M. Raymond, and Louis E. Lemley, New Orleans, La., assignors of one-third to William Thomas Coats, same place. Filed May 6, 1897. Serial No. 635,414.

November 9.

593,276. Gas and Air Mixer. Edmund Meredith, Philadelphia, Pa., assignor to the Pennsylvania Globe Gas Light Company of Pennsylvania. Filed Feb. 27, 1897. Serial No. 625,402.

593,296. Oil and Gas-Engine. Jean J. Heilmann, Paris, France. Filed Feb. 17, 1897. Serial No. 623,887. Patented in France Dec. 26, 1895, No. 252,742; in Belgium July 6, 1896, No. 122,364; in England July 9, 1896, No. 15,197; in Switzerland July 11, 1896, No. 12,687; in Hungary Aug. 11, 1896, No. 6,769, and in Austria Aug. 11, 1896, No. 3,373/46.

593,342. Gas-Burner. August E. Vogler, Hoboken, N. J., and Charles G. Richardson, New Brighton, N. Y. Filed Apr. 20, 1896. Serial No. 633,058.

593,364. Incandescent Gas-Burner. Silas H. Moore, New York, N. Y. Filed Feb. 9, 1897. Serial No. 622,622.

593,365. Incandescent-Light Burner. Emil H. C. Oehlmann, Berlin, Germany. Filed May 4, 1896. Serial No. 590,209.

593,453. Gas-Burner. Horace W. Billington, Jersey City, N. J. Filed June 9, 1897. Serial No. 639,982.

593,546. Mechanical Poker for Gas Furnaces. Levartt Armison, Buffalo, N. Y. Filed June 27, 1895. Renewed Mar. 16, 1897. Serial No. 627,893.

November 16.

593,619. Multiple Gas-Burner. David P. Stirk, Indianapolis, Ind. Filed Apr. 13, 1896. Serial No. 587,389.

593,623. Gas-Stove Burner. Martin A. Thiel, Milwaukee, Wis. Filed Feb. 4, 1897. Serial No. 621,913.

593,628. Generator for Acetylene Gas. Benjamin F. Williams, Quanah, Tex. Filed Nov. 18, 1896. Serial No. 612,582.

593,730. Gas-Burner. Samuel G. Stoddard, Bridgeport, Conn., assignor to the Bridgeport Brass Company, same place. Filed July 16, 1897. Serial No. 644,858.

593,785. Gas-Burner. William D. Smith, Chicago, Ill., assignor of two-thirds to Franklin W. Daniels and W. Jay Anderson, same place. Filed Jan. 6, 1896. Serial No. 574,508.

593,859. Gas-Engine. Albert Rosenberg, Baltimore, Md. Filed May 1, 1896. Serial No. 589,881.

593,865. Gas-Producer. Benjamin Talbot, Pencoyd, Pa., assignor of one-fourth to William B. Hughes, Philadelphia, Pa. Filed Jan. 27, 1896. Serial No. 577,041.

593,893. Gas-Producer. William B. Hughes, Philadelphia, Pa. Filed Nov. 27, 1896. Serial No. 613,600.

593,894. Gas-Producer. William B. Hughes, Philadelphia, Pa. Filed Apr. 7, 1897. Serial No. 631,184.

593,904. Atmospheric Burner or Heater. William Parfrey, New York, N. Y., assignor to himself, Richard K. Owens and George Cody, same place. Filed July 30, 1896. Serial No. 601,088.

593,911. Vaporizing - Carbureter and Air - Governor for Gas-Engines. Franklin F. Snow, Benton Harbor, Mich. Filed Nov. 7, 1896. Serial No. 611,362.

593,970. Muffler for Gas-Engines. Charles A. Schwarm, Pittsburg, Pa., assignor of one-half to George Trautman, same place. Filed Sept. 28, 1896. Serial No. 607,166.

November 23.

593,991. Manufacture of Mantles or Incandescing Bodies for Incandescent Gas-Lamps. John F. Duke, London, England. Filed July 27, 1896. Serial No. 600,690.

594,146. Valve-Gear for Gas or Oil-Engines. Charles Wood, London, England. Filed Dec. 30, 1896. Serial No. 617,476.

594,175. Acetylene-Gas Generator. Otto S. Hellwig, Chicago, Ill., assignor to George P. Fisher, Jr., same place. Filed Apr. 30, 1897. Serial No. 634,569.

594,251. Fuel-Gas-Burner. Robert Henderson, Pittsburg, Pa. Filed Jan. 26, 1897. Serial No. 620,838.

594,260. Valve-Gear for Gas-Engines. Frank S. Mead, Montreal, Canada. Filed Nov. 14, 1896. Serial No. 612,061.

November 30.

594,372. Igniter for Explosive-Engines. William Bayley, Springfield, Ohio. Filed July 14, 1896. Serial No. 599,173.

594,376. Automatic Lighting Device for Gas-Burners. Hugo Borchardt, Berlin, Germany. Filed Feb. 12, 1897. Serial No. 623,154.

594,377. Means for Holding Platinum Sponges in Automatic Gas-Lighters. Hugo Borchardt, Berlin, Germany. Filed June 18, 1897. Serial No. 641,290.

594,381. Valve-Gear for Gas-Engines. Edmund Cellison, Philadelphia, Pa., assignor to the Pennsylvania Iron Works Company, same place. Filed Oct. 21, 1896. Serial No. 609,631.

594,394. Gas-Broiler. James Gibbons, Jr., Jersey City, N. J. Filed May 27, 1896. Serial No. 593,215.

594,435. Combined Gas and Electric Generator Plant. Sidney H. Short, Cleveland, Ohio. Filed May 4, 1896. Serial No. 590,221.

594,460. Gazogene. André Clouard, Caen, France. Filed Nov. 25, 1895. Serial No. 569,997. Patented in France Apr. 24, 1895. No. 246,795.

594,480. Apparatus for Washing Gas. Owen F. Leibert, Bethlehem, Pa. Filed Apr. 8, 1896. Serial No. 586,665.

594,483. Gas-Producer. Kerr M. Mitchell, St. Joseph, Mo., and John Harleman, Kansas City, Kan. Filed Feb. 5, 1897. Serial No. 622,074.

594,537. Gas-Producer. Arthur Kitson, Philadelphia, Pa., assignor to Appleton L. Clark. Filed Mar. 18, 1896. Serial No. 583, 825.

594,539. Gas-Producer. Arthur Kitson, Philadelphia, Pa., assignor to Appleton L. Clark. Filed May 10, 1897. Serial No. 635,948.

594,540. Apparatus for Manufacturing Gas. Arthur Kitson, Philadelphia, Pa., assignor to Appleton L. Clark. Filed June 3, 1897. Serial No. 639,218.

594,574. Compound Generative Burner. Rinaldo R. Stafford, Hoboken, N. J., assignor, by mesne assignments, to the United Fuel Gas Generator Company, of New Jersey. Filed Aug. 28, 1896. Serial No. 604,160.

594,742. Gas-Generating Machine. Frank A. Hutter, New Haven, Conn., assignor to Emilie Hutter, same place. Filed Sept. 4, 1896. Serial No. 604,831.

594,816. Burner for Gas Fireplaces or Stoves. William G. Taylor, Hulton, Pa., assignor to the Taylor Burner and Electroplating Co., Ltd., Pittsburg, Pa. Filed Feb. 20th, 1895. Serial No. 539,106.

594,826. Acetylene-Gas Generator. James S. Ferguson, Minneapolis, Minn. Filed July 19, 1897. Serial No. 645,040.

December 7.

594,849. Acetylene-Gas Generator. Gianni Bettini, New York, N. Y. Filed Sept. 3, 1896. Serial No. 604,719.

595,016. Electrical Igniter for Gas-Engines. Benjamin W. Grist and Edmund Cellison, Philadelphia, Pa., assignors to the Pennsylvania Iron Works Company, same place. Filed Aug. 21, 1896. Serial No. 603,524.

595,023. Device for Lighting Gas. Coleman T. Lynd, San Francisco, Cal., assignor of one-half to Belle M. Miller, same place. Filed Mar. 5, 1897. Serial No. 626,125.

595,039. Machinery for Discharging Gas-Retorts. Gaston A. Bronder, New York, N. Y. Filed May 20, 1897. Serial No. 637,321.

595,043. Gas-Engine. John Q. Chase, Dayton, Ohio. Filed May 28, 1896. Serial No. 593,477.

595,050. Distributing and Igniting Device for Gas-Engines. Hermann Ebbs, Magdeburg, Germany, assignor to the Fried Krupp Grusonwerk, same place. Filed Nov. 6, 1895. Serial No. 568,126. Patented in Germany Oct. 12, 1892. No. 72,852, and in England Jan. 12, 1894. No. 752.

595,119. Acetylene-Gas Generator. James H. Couper, Atlanta, Ga. Filed July 8, 1896. Serial No. 598,450.

595,124. Receiver for Gases or Liquids. Rudolf Kelting, Eschweiler 2, Germany. Filed Mar. 5, 1897. Serial No. 626,175. Patented in Germany Mar. 5, 1896, No. 93,146; in France Feb. 20, 1897, No. 264,248; in Belgium Feb. 20, 1897, No. 126,466; in Austria Feb. 20, 1897, No. 23,525, and in England Feb. 20, 1897, No. 4,676.

595,142. Safety Gas-Cock. Rudolph Busse, Bethlehem, Pa. Filed Aug. 19, 1897. Serial No. 648.817.

595,230. Combined Lamp and Acetylene-Generator. Louis D. Wittemore, Jr., Stamford, Conn. Filed Jan. 8, 1897. Serial No. 618,451.

December 14.

595,317. Gas-Burner. Ernst Lindner, New York, N. Y. Filed Dec. 3, 1896. Serial No. 614,308.

595,324. Fuel-Engine. Carl K. MacFadden, Chicago, Ill., and Ernest F. Lloyd, Fort Wayne, Ind. Filed May 14, 1896. Serial No. 591,474.

595,451. Acetylene-Gas Generator. Charles P. Choquette and Antoine M. Morin, St. Hyacinthe, Canada. Filed June 11, 1896. Serial No. 595,184. Patented in England June 13, 1896, No. 13,115; in France June 20, 1896, No. 244,818, and in Canada Feb. 12, 1897, No. 54,976.

595,489. Gas-Engine. Edwin Meredith, Batavia, Ill. Filed Sept. 18, 1895. Serial No. 562,886.

595,497. Oil, Gas, or Like Engine. Walter Rowbotham, Birmingham, England. Filed Apr. 30, 1896. Serial No. 589,775.

595,621. Acetylene-Gas-Generating Lamp. André Gobron, Paris, France. Filed Mar. 15, 1897. Serial No. 627,603.

595,625. Gas-Engine. Albert L. Harbison, New Brighton, Pa. Filed Apr. 25, 1896. Serial No. 589,042.

595,658. Carbureter. Nathaniel Z. Seitz, Washington, D. C. Filed Sept. 29, 1896. Serial No. 607,306.

595,668. Acetylene-Gas Machine. Henry Bryant, Aransas Pass, Tex. Filed Nov. 4, 1896. Serial No. 611,041.

December 21.

595,762. Gas-Burner. Frank M. Brooks, Brooklyn, N. Y. Filed Apr. 10, 1897. Serial No. 631,517.

596,816. Apparatus for Producing Acetylene Gas. Gustave Lebrun and Fernand Cornaille, Paris, France. Filed Jan. 9, 1897. Serial No. 618,541. Patented in France July 17, 1896, No. 257,301.

596,839. Process of Manufacturing Incandescible Material. William L. Voelker, Elizabeth, N. J., assignor to the Voelker Light Company of New Jersey. Filed May 1, 1897. Serial No. 634,772.

596,846. Holder for Incandescent Mantles. George H. Chinnock, Brooklyn, N. Y., assignor to the Voelker Light Company of New Jersey. Filed Apr. 20, 1897. Serial No. 632,946.

596,848. Burner for Burning Rich Gases, Especially Acetylene Gas. Edward J. Dolan, Philadelphia, Pa., assignor, by mesne assignments, to the Acetylene House Lighting Company of West Virginia. Filed Apr. 29, 1897. Serial No. 634,376.

596,857. Gas-Generator. Commodore R. Miller, Pittsburg, Pa., assignor, by mesne assignments, to the W. J. McClurg Gas Construction Company, same place. Filed Mar. 17, 1894. Serial No. 504,033.

595,858. Gas-Producer. Commodore R. Miller, Pittsburg, Pa., assignor, by direct and mesne assignments, to the W. J. McClurg Gas Construction Company, same place. Filed May 11, 1895. Serial No. 548,941.

595,916. Gas-Mixer. William Langsenkamp, Jr., Indianapolis, Ind. Filed Dec. 5, 1895. Serial No. 571,187.

595,921. Self-Closing Cock or Valve for Gas, etc. John B. Richards, New York, N. Y. Filed Apr. 6, 1897. Serial No. 630,981.

595,924. Acetylene-Gas Apparatus. Walter A. Ruhe and Henry S. Burbank, Philadelphia, Pa. Filed Mar. 26, 1897. Serial No. 629,338.

595,979. Gas-Making Apparatus. Lawrence W. Swem, West Liberty, Iowa. Filed Jan. 21, 1897. Serial No. 620,094.

596,018. Gas-Producer. Arthur Kitson, Philadelphia, Pa. Filed July 23, 1897. Serial No. 645,709.

December 28.

596,103. Acetylene-Gas Generator. Frank D. Dibble, Minneapolis, Minn., assignor, by direct and mesne assignments, to the American Acetylene-Gas Company, same place. Filed July 10, 1896. Serial No. 598,711.

596,112. Acetylene-Gas-Burner. Leonard Henkle and Frederick H. Goddard, Rochester, N. Y. Filed Apr. 3, 1897. Serial No. 630,639.

596,138. Acetylene-Gas Generator. Daniel R. Blanchard, La Crosse, Wis. Filed Feb. 1, 1897. Serial No. 621,501.

596,139. Process of Generating Acetylene Gas. Werner Bolton, Leipsic, Germany, assignor, by mesne assignments, to James A. Deuther, Boston, Mass. Filed Oct. 16, 1895. Serial No. 565,895.

596,144. Burner for Burning Rich Gases, Especially Acetylene Gas. Edward J. Dolan, Philadelphia, Pa., assignor, by mesne assignments, to the Acetylene House Lighting Company of West Virginia. Filed Apr. 29, 1897. Serial No. 634,375.

596,236. Electric Gas-Lighting Device. Adrian L. Bogart, New York, N. Y., and Le Roy S. White, Waterbury, Conn. Filed May 7, 1897. Serial No. 635,488.

596,239. Gas-Engine. Jess B. Fenner, Buffalo, N. Y., assignor to the J. W. Ruger Manufacturing Co., same place. Filed Jan. 27, 1897. Serial No. 620,857.

596,258. Gas-Burner. George Bray, Leeds, England. Filed Jan. 26, 1897. Serial No. 620,738. Patented in England Aug. 27, 1894, No. 16,295.

596,295. Machine for Removing Packing from Joints. David W. French, Hoboken, N. J. Filed Apr. 8, 1897. Serial No. 631,216.

596,321. Gas-Generating Machine. Louis T. Bulley, New Haven, Conn. Filed Jan. 30, 1897. Serial No. 621,313.

596,352. Compound Gas-Engine. Edward R. Bales, Centralia, Ill. Filed Oct. 24, 1896. Serial No. 609,871.

596,428. Apparatus for Producing Gas. James G. Sanderson, Scranton, Pa. Filed October 15, 1894. Serial No. 525,998.

January 4, 1898.

596,560. Process of and Apparatus for Generating Gas. Abraham T. Welch, Washington, D. C. Filed Mar. 5, 1894. Renewed May 3, 1897. Serial No. 634,966.

596,577. Acetylene-Gas-Burner. Edward J. Dolan, Philadelphia, Pa., assignor, by mesne assignments, to the Acetylene House Lighting Company of West Virginia. Filed Apr. 5, 1897. Serial No. 630,795.

596,578. Gas-Burner. Edward J. Dolan, Philadelphia, Pa., assignor, by mesne assignments, to the Acetylene House Lighting Company of West Virginia. Filed Apr. 3, 1897. Serial No. 630,622.

596,613. High-Pressure Gas-Engine. Wilhelm von Oechelhaeuser, Dessau, Germany. Filed Apr. 20, 1897. Serial No. 633,050. Patented in Belgium Nov. 7, 1896, No. 124,436, and in France Nov. 7, 1896, No. 261,086.

596,658. Apparatus for Producing Uniform Mixtures of Air and Inflammable Vapor. Ludwig Feil, Amberg, Germany. Filed Jan. 28, 1897. Serial No. 621,017.

596,742. Starting Apparatus for Gas-Engines. Walker L. Crouch, New Brighton, Pa., assignor to the Pierce-Crouch Engine Company, same place, Filed Apr. 5, 1897. Serial No. 630,877.

596,809. Gas-Engine. Clinton Guyer, Muncy, Pa. Filed Apr. 2, 1897. Serial No. 630,339.

596,900. Gas-Burner. Wm. A. Mitchell, Saco, Me., assignor of one-third to Jasper D. Cochrane, same place. Filed Mar. 23, 1897. Serial No. 628,809.

596,937. Acetylene-Gas Apparatus. James G. Kerr, Niagara, Canada, assignor, by direct and mesne assignments, of one-half to Henry W. Smith, same place, and Christopher Fry, Copetown, Canada. Filed Mar. 15, 1897. Serial No. 627,644.

January 11.

597,011. Incandescent Gas-Burner. Daniel Meyer, Paris, France. Filed May 15, 1897. Serial No. 636,791. Patented in France Nov. 19, 1896, No. 261,415; in Belgium Feb. 9, 1897, No. 126,270; in Luxemburg Feb. 9, 1897, No. 2,753, and in England Apr. 6, 1897, No. 8,759.

597,024. Vessel for Containing Liquid Gases. Constanz Schmitz, Berlin, Germany. Filed May 11, 1897. Serial No. 636,079.

597,029. Gas-Stove. Friedrich Siemens, Dresden, Germany. Filed Nov. 19, 1895. Serial No. 569,455. Patented in Italy Dec. 21, 1894, LXXIV, 205.

597,057. Acetylene-Gas-Burner. Edward J. Dolan, Philadelphia, Pa., assignor, by mesne assignments, to the Acetylene House Lighting Company, of West Virginia. Filed Mar. 12, 1897. Serial No. 627,202.

597,181. Safety Gas-Cock. Eugene A. Haney, Boston, Mass. Filed Apr. 16, 1897. Serial No. 632,469.

597,258. Device for Separating Gas and Oil from Water. Manley W. Bovee, Goodwill Hill, Pa., assignor to himself, and Edmund R. Young, Titusville, Lorenzo D. Patterson, Tidionte, and Frank A. Wood, Grand Valley, Pa. Filed Feb. 27, 1897. Serial No. 625,253.

597,291. Acetylene-Gas Apparatus. Julius Leede, Minneapolis, Minn. Filed Dec. 28, 1896. Serial No. 617,227.

597,319. Gas-Burner. Ellis T. Jones, Hoboken, N. J., assignor to Thomas Adams, Jr., Brooklyn, N. Y. Filed Aug. 22, 1896. Serial No. 603,561.

597,326. Gas-Engine. Charles Quast, Marion, Ohio. Filed Mar. 8, 1894. Serial No. 502,882.

January 18.

597,392. Gas-Stove. Patrick J. Cassidy, Columbus, Ohio. Filed Nov. 18, 1896. Serial No. 612,557.

597,484. Gas-Meter. John Tourtel, London, England. Filed July 9, 1896. Serial No. 598,602. Patented in Belgium May 9, 1896. No. 121,275.

597,495. Acetylene-Gas Heater. Edward J. Dolan, Philadelphia, Pa., assignor, by mesne assignments, to the Acetylene House Lighting Company, of West Virginia. Filed July 27, 1897. Serial No. 646,077.

597,600. Gas-Burner. Abraham Anzelewitz, New York, N. Y. Filed July 22, 1897. Serial No. 645,570.

January 25.

597,749. Differential Gas-Motor. George G. Smith, St. Albans, Vt. Filed May 10, 1897. Serial No. 635,802.

597,771. Gas-Engine. Herbert H. Hennegin, St. Louis, Mo. Filed June 16, 1896. Serial No. 595,796.

597,783. Apparatus for Compressing Gas for Incandescent Gas-Lamps. Georg Rothgiesser, Dusseldorf, Germany, assignor to the Internationale Hydro-Press-Gas-Compagnie, Hamburg, Germany. Filed June 9, 1897. Serial No. 640,005.

597,803. Incandescent Gas-Burner. Joseph B. de Léry, New York, N. Y. Filed Oct. 14, 1897. Serial No. 655,167.

597,860. Explosive-Engine. Spencer Rolfe, Teddington, England, assignor of one-half to Frederick Hornby, Boscombe, England. Filed Mar. 13, 1897. Serial No. 627,332.

597,897. Safety Gas-Cock. John Dunlop, Meriden, Conn., assignor of one-half to Hugh Higginson, same place. Filed Feb. 10, 1897. Serial No. 622,752.

597,900. Acetylene-Gas Generator. John C. Gallagher, Elmira, N. Y., assignor of two-thirds to David W. Payne and M. C. Arnot, same place. Filed Dec. 18, 1896. Serial No. 616,111.

597,921. Explosive-Engine. Elias D. Strong, Chicago, Ill. Filed Jan. 25, 1897. Serial No. 620,680.

597,937. Acetylene-Generator. Harold J. Bell, Niagara, Canada, assignor to the Niagara Falls Acetylene Gas Machine Company, same place. Filed Aug. 12, 1897. Serial No. 648,008.

598,025. Gas-Engine. Samuel S. Simrak, San Francisco, Cal., assignor to Albert R. Herman, same place. Filed June 22, 1896. Serial No. 596,505.

598,047. Gas-Burner. George I. Woolaver, Quincy, Mass. Filed June 21, 1897. Serial No. 641,658.

598,048. Apparatus for Producing Acetylene Gas. Richard F. Carter, Niagara, Canada. Filed Jan. 16, 1897. Serial No. 619,447. Patented in England Jan. 28, 1897, No. 2,284.

598,059. Gas-Lamp. Walter J. Smart, South Orange, N. J. Filed Feb. 28, 1896. Serial No. 581,113.

February 1.

598,213. Acetylene-Gas Generator. Corydon L. Wilson, John W. Unger, Charles Muma, Amos P. Brosius, and Joseph C. Kuchel, Holstein, Iowa. Filed Nov. 13, 1896. Serial No. 611,986.

598,316. Electric Gas-Lighting Apparatus. Christian Eichmann, Indianapolis, Ind. Filed July 3, 1897. Serial No. 643,484.

598,393. Gas-Generator. Walter Sams, Clinton, Mo., assignor to William E. Sams and Frank B. Wadell, same place. Filed May 24, 1897. Serial No. 637,899.

February 8.

598,496. Gas-Engine. Leopold F. Burger, Dayton, Ohio, assignor of three-fourths to Victor P. Van Horne, same place. Filed Sept. 17, 1896. Serial No. 606,151.

598,499. Feed-Water Regulator, Gas Cut-Off and Alarm for Boilers. John W. Dearduff, Mollie, Ind., assignor of one-half to Wm. J. Baker, Montpelier, Ind. Filed July 2, 1897. Serial No. 643,247.

598,552. Gas-Stove. William S. Alter, Tarentum, Pa. Filed Feb. 8, 1897. Serial No. 622,507.

598,707. Apparatus for Eliminating Napthaline from Gas. Louis J. Hirt, Brookline, Mass. Filed June 26, 1897. Serial No. 642,374.

598,737. Gas-Burning Apparatus. Thomas E. McCaffrey and Peter F. McCaffrey, Allegheny, Pa. Filed Dec. 17, 1896. Serial No. 616,092.

598,767. Apparatus for Producing Acetylene Gas. Richard F. Carter, Niagara, Canada. Filed July 16, 1897. Serial No. 644,782. Patented in England Jan. 28, 1897, No. 2,284.

598,832. Explosive-Engine. Alexander Winton, Cleveland, Ohio. Filed Nov. 27, 1896. Serial No. 613,617.

598,837. Acetylene-Gas Apparatus. Edwin Appleby, London, England, assignor of one-half to Hubert Fouracre Harris, same place. Filed Mar. 22, 1897. Serial No. 628,685. Patented in England Mar. 17, 1896, No. 5,976.

598,845. Muffler for Gas-Engines. Charles S. Bird, Jackson, Mich., assignor of one-half to Henry C. Ransom, same place. Filed Feb. 20, 1897. Serial No. 624,333.

598,868. Acetylene-Gas Generator. James L. Hardwick and Sidney O. Manville, Cedar Rapids, Iowa. Filed Oct. 29, 1896. Serial No. 610,409.

February 15.

598,892. Self-Closing Gas-Burner. Frank P. Barney, Norton, Mass. Filed Oct. 9. 1897. Serial No. 654,610.

598,921. Method of and Apparatus for Carbureting Water-Gas. Arthur G. Glasgow, London, England. Filed May 11, 1894. Serial No. 510,896. Patented in England Dec. 10, 1894, No. 24,005.

599,018. Composition of Matter for Incandescent Gas-Lamps. Angelo Simonini, New York, N. Y. Filed Aug. 19, 1897. Serial No. 648,840.

599,074. Acetylene-Gas Generator. Zadoc P. Dederick, Sherman, Tex. Filed Mar. 8, 1897. Serial No. 626,466.

599,098. Apparatus for Producing Acetylene Gas. Victor Hanotier and Georges Hostelat, Chimay, Belgium. Filed Mar. 3, 1897. Serial No. 625,897. Patented in France Oct. 8, 1896, No. 248,232, and Oct. 26, 1896, No. 260,723; in England Nov. 3, 1896, No. 24,558, and Dec. 4, 1896, No. 27,697; in Austria Jan. 11, 1897, No. 47,902; in Hungary Jan. 15, 1897, No. 8,455, and in Russia Mar. 3, 1897, No. 1,433.

599,121. Electric Gas-Lighting Apparatus. Wm. E. Cram and James H. L. Clegg, Boston, Mass.; said Clegg assignor to said Cram. Filed Apr. 30, 1897. Serial No. 634,583.

599,198. Lamp for Generating Acetylene Gas. Léopold Serres, Condat, France. Filed Dec. 29, 1896. Serial No. 617,366.

599,270. Apparatus for Generating Acetylene Gas. August K. Stein, Chicago, Ill., assignor of one-half to John Zimmerman, same place. Filed Nov. 9, 1896. Serial No. 611,483.

599,283. Safety Attachment for Gas-Stoves or Ranges. William De Freitas, New York, N. Y. Filed Oct. 18, 1895. Serial No. 566,071.

February 22.

599,316. Electric Igniter for Gas-Engines. Fitz E. Culver, Chicago, Ill. Filed Feb. 15, 1897. Serial No. 623,492.

599,347. Acetylene-Gas Generator. Peter McMurray, Welland, Canada. Filed July 22, 1897. Serial No. 645,631.

599,354. Electric Igniter for Explosive-Engines. Hubert F. Probert, Chicago, Ill. Filed Apr. 8, 1897. Serial No. 631,274.

599,375. Gas-Engine. Warren E. White, Garrett, Ind., assignor of one-half to Edward P. Fitzgerald, John B. Mager, and Emanuel B. Thumma, same place. Filed Sept. 16, 1895. Serial No. 562,712.

599,376. Gas-Engine Attachment. Warren E. White, Garrett, Ind., assignor of one-half to The Garrett Engine, Boiler and Machine Works, same place, Filed Apr. 9, 1897. Serial No. 631,401.

599,394. Acetylene-Gas Generator. Henry W. Laun and Ernest E. Laun, Chicago, Ill. Filed Dec. 24, 1896. Serial No. 616,866.

599,487. Ammonia-Gas Compressor. John J. Bailey, New York, N. Y. Filed Jan. 12, 1897. Serial No. 618,942.

599,496. Gas-Engine. James Fraser, London, England. Filed June 15, 1896. Serial No. 595,628.

599,538. Hydraulic Blower and Pressure Apparatus for Gas-Machines. Joseph Stubbers, Covington, Ky. Filed Dec. 27, 1895. Serial No. 573,492.

March 1.

599,779. Reversing Mechanism for Gas or Other Engines. Benjamin W. Grist, Philadelphia, Pa., assignor to the Pennsylvania Iron Works Company, same place. Filed Oct. 11, 1897. Serial No. 654,856.

599,809. Incandescent Gas-Burner. William L. Smith, Chicago, Ill. Filed May 14, 1897. Serial No. 636,590.

599,873. Gas-Lamp. Walter J. Smart, South Orange, N. J. Filed July 2, 1894. Serial No. 516,295.

599,915. Burner for Incandescent Gas-Lights. Albert H. Petereit, New York, N. Y. Filed June 11, 1897. Serial No. 640,385.

600,090. Welsbach or Other Incandescent Light. Ransom F. Rankin, Philadelphia, Pa. Filed Dec. 12, 1896. Serial No. 615,444.

March 8.

600,166. Gas-Burner. Michael J. O'Reilly, Buffalo, N. Y. Filed Dec. 23, 1895. Serial No. 572,992.

600,177. Acetylene-Gas Apparatus. Walter A. Ruhe and Henry S. Burbank, Philadelphia, Pa. Filed Apr. 5, 1897. Serial No. 630,714.

600,221. Apparatus for Making Gas. Ernst Grey, St. Louis, Mo., assignor of three-fifths to Roy F. Carter, same place. Filed Apr. 19, 1897. Serial No. 632,783. Patented in England Apr. 18, 1896, No. 8,239, and in Germany Apr. 25, 1896, No. 55,740.

600,298. Gas-Generator. Arnold J. Tackle, Oakland, Cal. Filed Apr. 15, 1897. Serial No. 632,285.

March 15.

600,563. Apparatus for Generating Acetylene Gas. Eugène G. Villejean and Henri J. J. Frossard, Paris, France. Filed Feb. 10, 1897. Serial No. 622,780. Patented in France July 18, 1896, No. 258,191.

600,614. Acetylene-Gas Generator. Frederick W. Hedgeland, Chicago, Ill. Filed July 9, 1897. Serial No. 643,986.

600,630. Lamp for Generating Acetylene Gas. John Zimmerman, Chicago, Ill. Filed June 12, 1897. Serial No. 640,463.

600,675. Gas-Engine. Joseph Lizotte, Quincy, Mass., assignor of one-half to Mellen N. Bray, Boston, Mass. Filed June 28, 1897. Serial No. 642,569.

600,727. Generator for Acetylene Gas. Rudolf Kühn, Rorschach, Switzerland. Filed July 10, 1896. Serial No. 598,632. Patented in Austria Mar. 30, 1896, No. 47/1,119; in Switzerland Apr. 27, 1896, No. 12,163; in France May 2, 1896, No. 256,059; in Germany May 2, 1896, No. 94,738; in Belgium Oct. 26, 1896, No. 124,191, and in Italy Nov. 26, 1896, No. 42,912.

600,754. Gas-Engine. Benjamin C. Vanduzen, Winton Place, Ohio, assignor, by direct and mesne assignments, to the Vanduzen Gas and Gasoline Engine Co., Cincinnati, Ohio. Filed June 15, 1891. Serial No. 396,404.

600,774. Incandescent Lamp for Liquid Hydrocarbons. Peter J. Fitzgerald, Boston, Mass. Filed August 10, 1897. Serial No. 647,687.

600,819. Explosive-Engine. Alexander Winton, Cleveland, Ohio. Filed June 26, 1896. Renewed Feb. 12, 1898. Serial No. 670,146.

600,846. Acetylene-Gas-Generating Lamp. Charles L. Zimmerman and John Zimmerman, Chicago, Ill.; said Charles L. Zimmerman assignor to said John Zimmerman. Filed June 18, 1897. Serial No. 641,292.

600,847. Lamp for Generating Acetylene Gas. John Zimmerman, Chicago, Ill., and Frederick L. White, Waterbury, Conn.; said White assignor to said Zimmerman. Filed June 18, 1897. Serial No. 641,352.

March 22.

600,868. Acetylene-Gas Generator. Henry M. Handshy, Chicago, Ill. Filed Dec. 15, 1896. Serial No. 615,739.

600,872. Means for Connecting Gas-Supply Pipes with Burners of Gas-Stoves. Helen Hommel, New York, N. Y. Filed Apr. 16, 1897. Serial No. 632,407.

600,884. Indicator for Gas or Vapor Stove Valves. Orville P. Moon, Lorain, Ohio. Filed Mar. 17, 1897. Serial No. 627,976.

600,954. Gas-Producer. James G. Sanderson, Scranton, Pa. Filed Feb. 10, 1897. Serial No. 622,816.

600,985. Acetylene-Gas Generator. Charles H. Campbell, Philadelphia, Pa., assignor to Edmund R. Bulkley, trustee, same place. Filed Dec. 28, 1896. Serial No. 617,168. Patented in England May 15, 1897, No. 12,120.

601,012. Gas-Engine. Fitz E. Culver, Chicago, Ill. Filed Dec. 14, 1896. Renewed Dec. 27, 1897. Serial No. 663,767. Patented in England Dec. 16, 1896, No. 28,842, and in France Mar. 22, 1897, No. 262,204.

601,039. Gas-Stove. Matthew Griswold, Jr., and David Shields, Erie, Pa., assignor to the Griswold Manufacturing Company, same place. Filed Feb. 2, 1897. Serial No. 621,672.

601,064. Process of Preserving Carbids. Isaiah L. Roberts, Niagara Falls, N. Y., assignor to himself, and Edward N. Dickerson, New York, N. Y. Filed Nov. 24, 1897. Serial No. 659,670.

601,069. Igniting Device. James T. Armstrong and Axel Orling, London, England. Filed Dec. 21, 1896. Serial No. 616,467.

601,190. Governor for Gas-Engines. Reuben Willetts, Beaver Falls, Pa. Filed Feb. 10, 1897. Serial No. 622,851.

601,210. Gas-Engine. Samuel E. Maxwell, New Castle, Pa., assignor to William H. Smith, same place. Filed Jan. 21, 1897. Serial No. 620,044.

March 29.

601,251. Coin-Box for Coin-Controlled Mechanism. Sheldon J. Glass, Milwaukee, Wis. Filed June 25, 1897. Serial No. 642,219.

601,351. Electric Lighter for Gas-Burners. Ladislas V. Lewitzki, Brussels, Belgium, assignor to the Compagnie Internationale pour l'Allumage et l'Extinction Instantanée du Gaz, same place. Filed April 15, 1897. Serial No. 632,336.

601,366. Method of and Apparatus for Producing Calcium Carbid. Corydon L. Wilson, Charles Muma, John W. Unger, Henry Schneckloth, Amos P. Brosius and Joseph C. Kuchel, Holstein, Iowa. Filed Feb. 13, 1897. Serial No. 623,331.

601,426. Gas-Burner. August Buerkle, Allegheny, Pa. Filed June 21, 1897. Serial No. 641,556.

601,432. Method of and Apparatus for Manufacturing Gas. John Coyne, Pittsburg, Pa. Filed Dec. 2, 1896. Serial No. 614,190.

601,576. Prepayment Gas-Meter. James T. Mahoney and Ebenezer F. Griffiths, Philadelphia, Pa.; said Mahoney assignor to said Griffiths. Filed June 30, 1897. Serial No. 642,954.

April 5.

601,791. Apparatus for Generating Acetylene Gas. John Flood and Joseph Kipling, Quebec, Canada. Filed Apr. 15, 1897. Serial No. 632,271.

601,888. Gas-Washing Apparatus. Albert E. Deacon, Chicago, Ill. Filed May 13, 1897. Serial No. 636,274.

602,002. Prepaid-Gas-Supply Meter. John D. Forster, London, England. Filed June 21, 1897. Serial No. 641,622.

602,040. Water-Heater. Charles R. Tyler and Charles F. Pries, Brooklyn, N. Y., said Tyler assignor to Charles F. Walther, same place. Filed Nov. 13, 1897. Serial No. 658,408.

602,041. Gas-Stove. Peter G. Van Wie, Piqua, Ohio, assignor to The Favorite Stove and Range Co., same place. Filed Aug. 27, 1895. Serial No. 560,681.

April 12.

602,189. Apparatus for Generating Acetylene Gas. Joseph A. Vincent, Philadelphia, Pa., assignor to the Electro Gas Company of West Virginia. Filed March 30, 1896. Serial No. 585,348.

602,202. Gas-Cock. Albert W. Tuckerman, Wakefield, Mass. Filed Sept. 21, 1897. Serial No. 652,422.

602,351. Gas Lighter. Thomas N. McNish, Kearney, N. J. Filed July 31st, 1897. Serial No. 646,584.

April 19.

602,424. Burner for Acetylene Gas. Johann S. Billwiller, Unteregggen, Switzerland. Filed Jan. 25, 1897. Serial No. 620,678. Patented in Switzerland Nov. 28, 1896, No. 13,268.

602,477. Explosive-Engine. John A. Secor, Brooklyn, N. Y. Filed Apr. 13, 1897. Serial No. 631,987.

602,505. Protector for Incandescent Mantles. Franz A. F. Graefe, Hamburg, Germany. Filed June 24, 1897. Serial No. 642,092. Patented in Germany Mar. 4, 1896, No. 56,121; in England Mar. 9, 1896, No. 5,306; in Austria June 20, 1896, No. 46/2,479, and in Belgium Dec. 9, 1896, No. 12/5,084.

602,548. Electric Controller for Gas-Regulator. William E. H. Williams and Paul Seiler, San Francisco, Cal. Filed May 13, 1897. Serial No. 636,364.

602,556. Gas or Gasolene Engine. Thomas M. Doyle, Fort Madison, Iowa, assignor of one-half to Maurice Wahrer, same place. Filed June 8, 1897. Serial No. 639,876.

602,696. Valve-Controlling Device for Gas-Burners. Joseph D. C. Chateau, Paris, France. Filed Dec. 31, 1896. Serial No. 617,623. Patented in France May 30, 1896, No. 256,784.

602,707. Explosive-Engine. George A. Newman, Cliff, Neb. Filed Feb. 16, 1897. Serial No. 623,689.

April 26.

602,820. Gas-Engine. Milton Beck, Racine, Wis. Filed Mar. 1, 1897. Serial No. 625,665.

602,828. Apparatus for Mixing Air and Gas. Wm. C. Clark, New York, N. Y., assignor to the Acetylene Apparatus Manufacturing Company of West Virginia. Filed July 27, 1897. Serial No. 646,064.

602,833. Process of Burning Acetylene Gas. Edward N. Dickerson, New York, N. Y. Filed Dec. 31, 1895. Serial No. 573,884.

602,835. Acetylene-Gas-Burner. Edward J. Dolan, Philadelphia, Pa., assignor, by mesne assignments, to the Acetylene House Lighting Company of West Virginia. Filed Jan. 6, 1897. Renewed Mar. 19, 1898. Serial No. 674,535.

603,073. Apparatus for Generating Acetylene Gas. Esteban Armanet, Mexico, Mexico. Filed Aug. 18, 1897. Serial No. 648,624. Patented in Mexico Aug. 11, 1897, No. 1,069.

603,079. Prepayment Gas-Meter. Ebenezer F. Griffiths, Philadelphia, Pa. Filed Oct. 13, 1897. Serial No. 655,041.

603,104. Coin-Controlled Meter. Joseph Herbert, Oakland, Cal. Filed Feb. 8, 1897. Renewed Nov. 4, 1897. Serial No. 657,428.

603,125. Gas-Engine. John Carnes and Charles W. McKibben, Lima, Ohio. Filed Apr. 27, 1897. Serial No. 634,086.

603,205. Acetylene-Gas Generator. John M. Raymond and Louis E. Lemley, New Orleans, La., assignors of one-third to William Thomas Coats, same place. Filed Sept. 28, 1897. Serial No. 653,360.

602,219. Gas-Burner. George A. Hall, New York, N. Y., assignor of one-half to George E. Dayton, same place. Filed March 17, 1897. Serial No. 628,042.

603,233. Safety Cut-Off for Gas-Cocks. Philip C. Folwell, Toronto, Canada, assignor of two-fifths to George H. Leslie and George Hambly, same place. Filed Apr. 24, 1897. Serial No. 633,796.

May 3.

603,273. Gas-Burner. Joseph F. Hewitt, Alleghany, Pa. Filed Feb. 5, 1897. Serial No. 622,084.

603,297. Oil or Gas Engine. Walter F. Trotter, Marshalltown, Iowa. Filed Sept. 13, 1895. Serial No. 562,422.

603,318. Oil-Gas Motor. Howard K. Clover, Council Bluffs, Iowa. Filed Aug. 5, 1895. Serial No. 558,350.

603,328. Gas-Producer. James Fraser, London, Eng. Filed June 15, 1896. Serial No. 595,629.

603,334. Electrical Attachment for Gas-Lights. Franklin L. Killner and George S. Barrows, Philadelphia, Pa., assignors to the Welsbach Light Company, Gloucester City, N. J. Filed Nov. 22, 1897. Serial No. 659,397.

603,397. Acetylene-Gas Generator. Thos. A. Bryan and James H. Couper, Baltimore, Md. Filed Jan. 6, 1898. Serial No. 665,730.

603,456. Gas-Stove. Albert L. Pitney, Washington, D. C., assignor to the Calovit Heating Co. Filed July 14, 1896. Serial No. 599,113.

603,473. Mantle for Incandescent Gas-Burners. Hinrich P. D. Ohlhaver, Hamburg, Germany. Filed July 15, 1897. Serial No. 644,705.

603,506. Acetylene-Gas Generator. Clarence R. Gillett and Otto S. Hellwig, Chicago, Ill.; said Hellwig assignor to said Gillett; said Gillett assignor to The Gillett Generator Company, same place. Filed Sept. 13, 1897. Serial No. 651,513.

603,535. Acetylene-Gas Generator. Wm. McGraw, Mount Airy, Ohio. Filed June 25, 1897. Serial No. 642,279.

603,613. Gas-Burner. Clarence S. Steward, Chattanooga, Tenn. Filed Feb. 8, 1897. Serial No. 622,424.

May 10.

603,655. Acetylene-Gas Generator. Calvin Ogburn, Phoenix, Ariz. Filed July 19, 1897. Serial No. 645,152.

603,661. Gas-Burner. Wm. W. Seeley, Brooklyn, N. Y. Filed July 29, 1897. Serial No. 646,407.

603,678. Acetylene-Generator. Edward N. Dickerson, New York, N. Y. Filed Aug. 12, 1897. Serial No. 647,958.

603,746. Acetylene-Gas Lamp. Oliver G. Seward, Minneapolis, Minn. Filed Oct. 15, 1896. Serial No. 608,924.

603,747. Acetylene-Gas Generator. Oliver G. Seward, Minneapolis, Minn. Filed Dec. 22, 1896. Serial No. 616,627.

603,850. Prepayment Gas-Meter. Charles W. Hinman, Boston, Mass. Filed Sept. 8, 1896. Renewed Nov. 11, 1897. Serial No. 658,205.

603,914. Gas or Oil Engine. Frank S. Mead, Montreal, Canada. Filed July 28, 1896. Serial No. 600,750.

603,971. Carbid-Cartridge. Georges de Roussy de Sales, Lyons, France. Filed Feb. 10, 1897. Serial No. 622,833. Patented in France Oct. 9, 1896, No. 260,580; in England Jan. 21, 1897, No. 1653; in Switzerland Jan. 21, 1897, No. 13,882; in Hungary Jan. 21, 1897, No. 8,604; in Belgium Jan. 21, 1897; No. 125,856; in Russia Jan. 23, 1897, No. 1,051; in Austria Mar. 13, 1897, No. 871, and in Italy Apr. 12, 1897, LXXXV, 478.

603,986. Explosive Engine. Charles E. Henriod, Bienne, Switzerland. Filed Mar. 4, 1898. Serial No. 672,622.

603,993. Device for Preventing Discharge of Gas. Adam S. Huffman, Pittsburg, Pa. Filed May 6, 1897. Serial No. 635,439.

603,998. Automatic Gas Shut-Off. John Baird, Uniontown, Pa. Filed July 12, 1897. Serial No. 644,195.

May 17.

604,025. Apparatus for Producing Acetylene Gas. Henri A. Deroy, Paris, France. Filed July 2, 1896. Serial No. 597,846. Patented in France April 4, 1896, No. 255,338; in Luxemburg, May 7, 1896, No. 2,535; in Belgium June 6, 1896, No. 121,769; in England June 9, 1896, No. 12,683; in Italy, June 9, 1896, No. 41,752/51, and in Tunis, June 11, 1896, No. 183.

604,039. Acetylene Gas Generator. Eugene Godin, Three Rivers, Canada. Filed Oct. 7, 1897. Serial No. 654,472. Patented in England July 19, 1897, No. 17,021; in France Nov. 18, 1897, No. 268,869, and in Canada Nov. 22, 1897, No. 58,185.

604,074. Automatic Igniting Device for Gas-Lamps, Etc. Carl F. Nebendahl, Wandsbeck, Germany. Filed Aug. 31, 1897. Serial No. 650,191.

604,102. Gas-Burner. Thomas Wilson, Philadelphia, Pa., assignor to the Pennsylvania Globe Light Company, of Pennsylvania. Filed Feb. 1, 1897. Serial No. 621,429.

604,116. Fuel-Gas Mixer. Andrew Krieger and John Coyle, Indianapolis, Ind., assignors to William Langsenkamp, Jr., same place. Filed Dec. 30, 1895. Serial No. 573,776.

604,121. Method of Incinerating Incandescent Gas-Mantles and Apparatus Therefore. Thomas J. McTighe, Brooklyn, N. Y., assignor to Charles H. Hoyt, New York, N. Y. Filed June 11, 1897. Serial No. 640,305.

604,139. Acetylene-Gas-Generating Apparatus. Edward N. Dickerson, New York, N. Y. Filed June 18, 1897. Serial No. 641,381.

604,140. Acetylene-Gas Generator. Edward J. Dolan, Philadelphia, Pa., assignor to the Acetylene House Lighting Company of West Virginia. Filed Oct. 30, 1897. Serial No. 656,893.

604,197. Safety Attachment for Gas Cocks. James F. Smith, San Francisco, Cal. Filed Dec. 15, 1897. Serial No. 661,948.

604,199. Apparatus for Generating Acetylene Gas. Frederick S. Thorn and Charles Hoddle, London, England. Filed Nov. 21, 1896. Serial No. 612,998. Patented in England July 18, 1896, No. 15,962; in France Mar. 22, 1897, No. 265,252; in Belgium June 2, 1897, No. 128,632, and in Canada Dec. 1, 1897, No. 58,234.

604,209. Gas-Burner for Water-Heaters. Henry F. Gabel, Pittsburg, Pa. Filed Nov. 3, 1897. Serial No. 657,257.

604,229. Apparatus for Manufacturing Acetylene Gas. Henri Cousin, Paris, France. Filed May 1, 1897. Serial No. 634,699. Patented in Belgium Nov. 28, 1896, No. 124,866; in Luxemburg Mar. 19, 1897, No. 2,788, and in England April 3, 1897, No. 8,552.

604,241. Gas-Engine. Daniel M. Tuttle, Oneida, N. Y. Filed Dec. 17, 1896. Serial No. 615,965.

May 24.

604,406. Automatic Gas-Vending Apparatus. Charles P. Mayer and John H. Pomeroy, New Haven, Conn. Filed Sept. 24, 1897. Serial No. 652,811.

604,427. Apparatus for Manufacturing Gas. Henry C. Shields, Troy, N. Y. Filed Dec. 27, 1895. Serial No. 573,463.

604,617. Safety Gas Fixture. Albert N. Hoxie, Boston, Mass., assignor of two-thirds to Nathaniel C. Merrill, New York, N. Y. Filed Aug. 18, 1897. Serial No. 648,643.

604,659. Apparatus for Using Liquefied or Compressed Gas. Joseph B. Fournier, Paris, France. Filed Oct. 22, 1896, Serial No. 609,762. Patented in France Mar. 30, 1896, No. 255,138.

604,667. Appararatus for Generating Acetylene Gas. Georges de Roussy de Sales, Lyons, France. Filed Feb. 15, 1897. Serial No. 623,459. Patented in France Oct. 24, 1896, No. 260,714; in Belgium Jan. 23, 1897, No. 125,962; in Hungary Jan. 25, 1897, No. 8,389; in Switzerland Jan. 27, 1897, No. 13,991; in England Jan. 28, 1897, No. 2,292; in Austria Feb. 16, 1897, No. 505, and in Italy Apr. 5, 1897, LXXXV, 402.

May 31.

604,863. Pipe-Joint. Gustav Hoyer, Schönebeck, Germany, assignor to the Fahrradwerke, vormals Hoyer & Glahn, same place. Filed Aug. 13, 1897. Serial No. 648,112.

604,879. Acetylene-Gas Generator. William W. Goodwin, Bordentown, N. J. Filed Apr. 13, 1896. Serial No. 587,401.

604,967. Acetylene-Gas Apparatus. Daniel H. Chivert, Newilly-sur-Seine, France. Filed Sept. 19, 1896. Serial No. 606,338. Patented in France Feb. 1, 1896, No. 253,620, and Aug. 18, 1896, No. 258,984; in Belgium Apr. 7, 1896, No. 120,742; in England Aug. 28, 1896, No. 19,059; in Austria Aug. 31, 1896, No. 46/256; in Hungary Sept. 3, 1896, No. 7,168; in Italy Sept. 4, 1896, No. 42,441; in Spain Sept. 5, 1896, No. 19,602; in Portugal Sept. 25, 1896, No. 2,315, and in Argentine Republic Oct. 30, 1896, No. 1,957.

June 7.

605,132. Cut-Off for Gas-Jets. Lawson Ramage, Holyoke, Mass. Filed Nov. 11, 1897. Serial No. 658,159.

605,137. Apparatus for Generating Acetylene Gas. John W. Scarth, Pudsey, and William A. Thornton, Wetherby, England. Filed Oct. 25, 1897. Serial No. 656,339.

605,168. Gas-Regulator. Adolph Kuhne, New York, N. Y., assignor of one-half to James C. Meeks, same place. Filed July 15, 1897. Serial No. 644,627.

605,250. Incandescent Gas-Lamp. Ferdinand Christoph von Heydebrand und der Lasa, New York, and Joseph Lock, Brooklyn, N. Y., assignors to the Heydebrand Incandescent Light Company, New York, N. Y. Filed May 24, 1897. Serial No. 637,920.

605,333. Igniter for Explosive-Engines. Oscar Owens, San Francisco, Cal., assignor to the American Type Founders Company. Filed Nov. 27, 1896. Serial No. 613,671.

605,397. Acetylene-Gas Generator. James H. Couper, Baltimore, Md., assignor to the Bryan Manufacturing Co., same place. Filed July 20, 1897. Serial No. 645,293.

605,398. Acetylene-Gas Generator. James H. Couper and Thomas A. Bryan, Baltimore, Md. Filed Oct. 5, 1897. Serial No. 654,118.

June 14.

605,560. Gas-Heater. Michael Zippler, Allegheny, Pa. Filed May 10, 1897. Serial No. 635,794.

605,562. Incandescent Gas-Burner. John W. Bragger, Watertown, N. Y., assignor to the Hitchcock Lamp Company, same place. Filed Oct. 30, 1897. Serial No. 656,902.

605,725. Gas-Stove. John Langfield, Manchester, England. Filed Mar. 4, 1898. Serial No. 672,575.

605,815. Gas-Engine. James F. Duryea. Springfield, Mass., assignor to the Duryea Motor Wagon Company, same place. Filed June 14, 1897. Serial No. 640,697.

June 21.

605,868. Process of and Apparatus for Burning Acetylene Gas. Maximilian Grimm, West Hoboken, N. J., assignor to Edward N. Dickerson and Julius J. Suckert, New York, N. Y. Filed Jan. 15, 1897. Serial No. 619,357.

605,886. Burner for Acetylene or Other Gases. Gustav Lebrun and Fernand Cornaille, Paris, France. Filed Oct. 5, 1897. Serial No. 654,102. Patented in France Mar. 4, 1897, No. 264,662, and in Belgium Mar. 5, 1897, No. 126,739.

605,926. Acetylene-Gas Generator. Elmer E. Shuler, Havelock, Neb. Filed Oct. 6, 1897. Serial No. 654,254.

605,958. Apparatus for Generating Acetylene Gas. Arthur B. Griffen, Verona, N. J., assignor to the Acetylene Apparatus Manufacturing Company, of West Virginia. Filed Nov. 16, 1896. Serial No. 612,173.

605,960. Incandescent Gas-Light Tassel. Lucy Hooker, Sydney, New South Wales. Filed Sept. 24, 1897. Serial No. 652,915.

605,991. Apparatus for Gas Analysis. Otto Bleier, Vienna, Austria-Hungary. Filed June 10, 1897. Serial No. 640,276.

606,037. Apparatus for Generating Acetylene Gas. Henry H. Suplee, Philadelphia, Pa., assignor to Cornelius E. Baird, same place. Filed May 24, 1897. Serial No. 637,880.

606,068. Automatic Water-Heater. William L. Miller, Pittsburg, Pa. Filed Oct. 1, 1897. Serial No. 653,670.

606,126. Gas Water-Heater. Michael G. Cunningham, Bridgeport, Conn., assignor of one-half to Charles D. Woodruff, same place. Filed Mar. 7, 1898. Serial No. 672,828.

606,136. Burner. Charles Haffcke, Baltimore, Md. Filed May 15, 1897. Serial No. 636,663.

June 28.

606,224. Mantle or Hood for Welsbach or Other Incandescent Lights. Julius Moeller, London, England, assignor to the Welsbach Light Company, Gloucester City, N. J. Filed Dec. 1, 1896. Serial No. 614,061. Patented in England Jan. 31, 1895, No. 2,224.

606,225. Gas-Burner. Ragland Momand, New York, N. Y., assignor to the American Lighting Company, of New Jersey. Filed July 7, 1897. Serial No. 643,700.

606,226. Protector for Incandescent Burners. John W. McKnight, Philadelphia, Pa., assignor of three-fourths to Philip Lewin, Marcus Lewin, and Maurice S. Lewin, same place. Filed June 15, 1897. Serial No. 640,824.

606,228. Acetylene-Gas-Generating Lamp. Henry Oehl, New York, N. Y. Filed Aug. 4, 1897. Serial No. 647,016.

606,305. Acetylene-Gas Generator. Henry Schneckloth, Holstein, Iowa. Filed Mar. 1, 1897. Serial No. 625,622.

606,312. Electric Igniter for Gas-Engines. Arnold J. Tackle, Oakland, Cal. Filed Oct. 5, 1897. Serial No. 654,155.

606,385. Acetylene-Gas Lamp. Gustaf E. Hesse, Brooklyn, N. Y., assignor of two-thirds to George H. Robinson, New York, N. Y. Filed Nov. 2, 1897. Serial No. 657,144.

606,386. Gas-Engine. Thomas H. Hicks, Fort Wayne, Ind. Filed Nov. 29, 1895. Serial No. 570,421.

606,430. Gas-Compressor. Julius Sedlacek, Nuremberg, Germany. Filed Aug. 20, 1897. Serial No. 648,922. Patented in France Dec. 21, 1892, No. 226,556; in Germany Jan. 13, 1893, No. 77,119; in Austria-Hungary Mar. 18, 1893, No. 56,187, and No. 86,911, May 6, 1893, No. 1,089, and No. 5,637, and Aug. 30, 1893, No. 10,239, and No. 19,809; in Italy Mar. 28, 1893, No. 1,194; in Switzerland July 24, 1893, No. 7,363, and June 25, 1894, No. 8,798; in Belgium Aug. 25, 1894, No. 85,843, and in England May 14, 1895, No. 9,530.

606,435. Gas-Generating Gas-Fixture. John F. Williams, Kansas City, Kan., assignor to Robert M. Snyder, Kansas City, Mo. Filed June 8, 1897. Serial No. 639,919.

606,441. Acetylene-Gas Tip. Ludwig K. Böhm, New York, N. Y., assignor to the Electro Gas Company of West Virginia. Filed May 8, 1896. Renewed May 25, 1898. Serial No. 681,754.

606,504. Explosive-Engine. Samuel Bouton, Philadelphia, Pa., assignor of one-half to William F. Ruwell and Alfred Henwood, same place. Filed July 30, 1897. Serial No. 646,440.

606,539. Apparatus for Generating Acetylene Gas. Oscar Grenier and Julien Grand, Lyons, France. Filed Oct. 29, 1896. Serial No. 610,465. Patented in France Mar. 30, 1896, No. 255,154; in England Aug. 12, 1896, No. 17,904; in Italy Sept. 28, 1896, LXXXIII, 445; in Belgium Sept. 30, 1896, No. 123,596; in Luxemburg Oct. 9, 1896, No. 2,623; in Spain Nov. 21, 1896, No. 19,695; in Switzerland Feb. 28, 1897, No. 13,068; in Austria July 8, 1897, No. 47/2,649, and in Hungary July 15, 1897, No. 8,552.

606,625. Prepayment Fluid-Meter. Henry Green, Preston, England, assignor to himself, and Alexander C. Humphreys, and Arthur Graham Glasgow, New York, N. Y. Filed June 25, 1897. Serial No. 642,217. Patented in England Aug. 28, 1896, No. 19,067.

July 5.

606,660. Gas Heating and Expanding Device. John C. Henderson, New York, N. Y. Filed Aug. 4, 1897. Serial No. 647,121.

606,673. Acetylene-Gas Generator. Thomas E. Lewis, Dublin, Tex. Filed Nov. 8, 1897. Serial No. 657,867.

606,674. Acetylene-Gas Generator. Thomas E. Lewis, Dougherty, Ind. Ter. Filed Sept. 24, 1897. Serial No. 652,913.

606,861. Acetylene-Gas Generator. Emile Gossart, Bordeaux, France, Filed Dec. 31, 1897. Serial No. 665,207. Patented in France May 5, 1896, No. 255,978, and in Belgium Oct. 26, 1896, No. 124,199.

July 12.

607,049. Gas-Burner. Ellis T. Jones, Hoboken, N. J. Filed July 28, 1897. Serial No. 646,161.

607,276. Gas-Engines. Joseph Reid, Oil City, Pa., Filed Jan. 25, 1895. Serial No. 662,935.

607,317. Internal Combustion Engine. George L. Woodworth, Stanford University, California. Filed June 8, 1897. Serial No. 639,820.

607,406. Thermostat Gas-Regulator. John S. Coe, Paterson, N. J. Filed Jan. 4, 1898. Serial No. 665,558.

July 19.

607,536. Gas-Engine. Madison F. Bates, Lansing, Mich. Filed Nov. 9, 1896. Serial No. 611,472.

607,541. Heat-Generating Gas-Burner. Emanuel Herz, Berlin, Germany, Filed Apr. 28. 1896. Serial No. 589,416. Patented in Germany Mar. 5, 1896, No. 90,214.

607,566. Gas-Engine. Charles Jacobson, Erie, Pa. Filed Dec. 2, 1896. Serial No. 614,192.

607,580. Gas-Engine. Levi J. Wing, New York, N. Y. Filed Dec. 22, 1896. Serial No. 616,599.

607,613. Hydrocarbon-Gas Engine. William O. Worth, Benton Harbor, Mich. Filed July 1, 1895. Renewed July 3, 1897. Serial No. 643,467.

607,650. Acetylene-Gas Generator. Frederick H. Smith, Dunblane, Scotland. Filed Sept. 22, 1897. Serial No. 652,575.

607,655. Process of and Apparatus for Generating Power from Compressed Gases. Edward N. Dickerson, New York, N. Y. Filed Feb. 27, 1895. Serial No. 539,873.

607,662. Method of Utilizing Liquefiable Gases in Operating Engines, Etc. Edmund V. Roure, Philadelphia, Pa, assignor of two-thirds to Cornelius A. Lane and John L. Kelly, same place. Filed July 21, 1896. Serial No. 600,018.

607,701. Acetylene-Gas Generator. John A. Olson, Minneapolis, Minn. Filed Aug. 17, 1896. Serial No. 603,047.

607,756. Gas-Burner. William Ludlow, Buffalo, N. Y. Filed Jan. 14, 1898. Serial No. 666,726.

July 26

607,878. Gas-Engine. Charles Quast, Marion, Ohio. Filed Sept. 15, 1894. Serial No. 523,170.

607,879. Gas-Engine. Charles Quast, Bucyrus, Ohio. Filed Jan. 5, 1895. Serial No. 533,915.

607,903. Gas-Engine. William J. Wright, Pittsburg, Pa. Filed Apr. 26, 1897. Serial No. 633,951.

607,904. Gas-Engine. William J. Wright, Pittsburg, Pa. Filed May 20, 1897. Serial No. 637,450.

607,943. Method of Producing Ammonia. Hermann Mehner, Berlin, Germany. Filed Mar. 11, 1897. Serial No. 627,057. Patented in Luxemburg, Feb. 2, 1897, No. 2,746.

607,992. Igniter for Gas-Engines. Ralph B. Hain, Grand Rapids, Mich., assignor to the Monitor Vapor Engine and Power Company, same place. Filed Apr. 8, 1896. Serial No. 586,741.

608,100. Annunciator Gas-Fixture. John L. Bixby, Arlington, Mass., assignor to Nathaniel Conant, Brookline, Mass. Filed Nov. 26, 1897. Serial No. 659,754.

August 2.

608,270. Acetylene-Gas Generator. Walter S. Powers and Adrian J. Reynolds, Nashville, Mich. Filed Nov. 13, 1897. Serial No. 658,465.

608,298. Gas-Engine. John J. Ohrt, Burlington, Iowa. Filed Mar. 5, 1897. Renewed June 22, 1898. Serial No. 684,184.

608,395. Burner and Chimney-Holder. Jasper H. Moss, Topeka, Kan, assignor of forty-nine one hundredths to Channing J. Brown, same place. Filed Oct. 30, 1897. Serial No. 656,915.

608,409. Igniting Mechanism for Explosive-Engines. Joseph Lizotte, Quincy, Mass., assignor of one-half to Mellen N. Bray, Boston, Mass. Original application filed June 28, 1897. Serial No. 642,569. Divided and this application filed Nov. 17, 1897. Serial No. 658,800.

608,460. Acetylene-Gas Generator. Alexander Keith and James H. Byrne, Toronto, Canada. Filed May 6, 1897. Serial No. 635,287.

608,540. Gas-Burner. Adolph Beler, Allegheny, Pa., assignor to the Monarch Water Heater Company, Pittsburgh, Pa. Filed Mar. 27, 1897. Renewed May 6, 1898. Serial No. 680,084.

608,541. Acetylene-Gas Generator. Harold J. Bell, Niagara, Canada, assignor to himself and Elmer E. Almy and William H. Almy, Rochester, N. Y. Filed Mar. 5, 1898. Serial No. 672,732.

August 9.

608,571. Acetylene-Gas Generator. Frank E. Bundy, Elmira, N. Y. Filed Apr. 5, 1897. Serial No. 630,842.

608,643. Acetylene-Gas-Generating Apparatus. John Boland, Decatur, Ill., assignor of one-half to Charles E. Peebles, Raymond, Ill. Filed July 3, 1897. Serial No. 643,358.

608,804. Apparatus for Generating Acetylene Gas. Axel A. Strom, Austin, Ill., assignor, by mesne assignments, to the Walmsley & Company, Chicago, Ill. Filed June 14, 1897. Serial No. 640,734.

608,869. Acetylene-Gas Generator. Charles Kelly, Passaic, N. J., assignor to the Read Holliday and Sons, Limited, New York, N. Y. Filed Feb. 15, 1898. Serial No. 670,416.

608,944. Attachment for Gas-Engines, Joseph H. Wiehl, Zelienople, Pa., assignor of one-third to Wm. M. C. Jones, Pittsburg, Pa. Filed Apr, 21, 1897. Serial No. 633,098.

608,968. Gas or Oil Motor for Bicycles.. Wensel Morava, Chicago, Ill. Filed Mar. 22, 1897. Serial No. 628,573.

608,972. Water-Heater. John C. Beckfield, Pittsburg, Pa., assignor to the Monarch Water Heater Company, same place. Filed Feb. 18, 1897. Serial No. 623,991.

608,974. Valve for Gas Heaters. Alfred E. Detwiler, Milwaukee, Wis., assignor to the Milwaukee Gas Stove Company, same place. Filed Nov. 13, 1893. Serial No. 490,741.

608,985. Apparatus for Producing Acetylene Gas. Thomas Hennessy, Excelsior Springs, Mo. Filed Sept. 25, 1895. Renewed Oct. 27, 1897. Serial No. 656,581.

August 16.

609,034. Apparatus for Forming and Baking Incandescent-Light Mantles. William Mahler, New York, N. Y. Filed July 10, 1897. Serial No. 644,156.

609,150. Process of and Apparatus for Manufacturing Coke. John S. Kay, Sandal Magna, England. Filed Apr. 25, 1896. Serial No. 589,039. Patented in England May 27, 1895, No. 10,356.

609,189. Acetylene-Gas Generator. John Kirkham, Oakland, Cal., assignor of one-half to Joseph Von Wyl, same place. Filed Mar. 15, 1898. Serial 673,917.

609,226. Automatic Acetylene-Gas Machine. Charles S. Burton, Oak Park, Ill. Filed Nov. 23, 1896. Serial No. 613,051.

609,250. Electrical Igniter for Gas-Engines. Nikola Tesla, New York, N. Y. Filed Feb. 17, 1897. Renewed June 15, 1898. Serial No. 683,524.

609,313. Acetylene-Gas Generator. John A. Welton, Canal Dover, and Jesse V. Price, Gnadenhütten, Ohio. Filed Dec. 28, 1897. Serial No. 664,139.

August 23.

609,494. Acetylene-Gas Generator. Ludwig K. Böhm, New York, N. Y., assignor to the Electric Gas Company, of West Virginia. Filed June 1, 1896. Renewed May 25, 1898. Serial No. 681,755.

609,582. Process of and Composition for Making Gas. Louis G. Harris, Toronto, Canada. Filed Aug. 18, 1897. Serial No. 648,694.

609,596. Water-Heater. Joseph W. Taylor, Wilkinsburg, Pa., assignor of one-half to Harry W. McIntosh, Pittsburgh, Pa. Filed June 24, 1897. Serial No. 642,178.

609,656. Heating and Illuminating Attachment for Gas-Burners. Harry A. Bower, Chelsea, Mass., assignor to Wendell P. Lee and William H. Breen, Boston, Mass. Filed Jan. 4, 1897. Serial No. 617,895.

609,673. Acetylene-Gas-Generating Apparatus. James T. Hays and Thomas C. Hays, Emmitsburg, Md. Filed Mar. 31, 1898. Serial No. 675,963.

609,705. Gas-Producer. James G. Sanderson, Scranton, Pa. Filed Jan. 7, 1897. Serial No. 618,360.

609,761. Gas-Producer. Peter English, Benton Harbor, Mich., assignor of one-half to George H. Paine, Detroit, Mich. Filed May 1st, 1897. Serial No. 634,709.

August 30.

609,831. Carbureter. Clarence Le Roy Parker, Silver Creek, N. Y., assignor to David Parker, same place. Filed July 22, 1897. Serial No. 645,593.

609,861. Acetylene-Gas Generator. John Williamson, Chicago, Ill. Filed Aug. 30, 1897. Serial No. 649,926.

609,864. Process of and Apparatus for Producing Calcium Carbid. Matthew P. Wood, New York, N. Y. Filed Apr. 23, 1897. Renewed Jan. 27, 1898. Serial No. 668,230.

610,034. Gas-Engine. Allen H. Dingman, De Haven, Pa., assignor of one-half to James Amm, Buffalo, N. Y. Filed June 25, 1897. Serial No. 642,291.

610,040. Carbureter. Henry Ford, Detroit, Mich., assignor to William C. Maybury, trustee, same place. Filed Apr. 7, 1897. Serial No. 631,083.

610,055. Apparatus for Producing Acetylene Gas. Thomas Holliday, Huddersfield, England. Filed Nov. 18, 1896. Serial No. 612,590. Patented in England Mar. 16, 1896, No. 5,813, and Jan. 12, 1897, No. 885; in France July 11, 1896, No. 275,168; in Belgium June 16, 1896, No. 121,931; in Cape Colony Nov. 26, 1896, No. 1,256; in Transvaal, Dec. 9, 1896, No. 1,276; in Natal Dec. 31, 1896, No. 12; in Switzerland Jan 21, 1897, No. 13,621; in Hungary Jan. 21, 1897, No. 23,311; in Austria Jan. 21, 1897, No. 47/1,018; in India Feb. 17, 1897, No. 66; in Victoria Feb. 18, 1897, No. 13,949; in South Australia Feb. 19, 1897, No. 3,557; in New South Wales Feb. 20, 1897, No. 7,279; in Portugal Feb. 21, 1897, No. 2,409; in Tasmania Feb. 22, 1897, No. 1,831; in Queensland Feb. 22, 1897, No. 3,761; in Spain Feb. 23, 1897, No. 20,274; in New Zealand Feb. 27, 1897, No. 9,308; in West Australia Mar. 2, 1897, No. 1,538, and in Italy Apr. 28, 1897, LXXXVI, 76.

610,086. Acetylene-Gas Generator. Vincenzo Sardi, Turin, Italy. Filed Dec. 29, 1897. Serial No. 664,264. Patented in Italy Mar. 16, 1896, LXXX, 320, April 29, 1896, LXXXI, 185, and Sept. 4, 1896, LXXXIII, 239, in Belgium Sept. 17, 1896, No. 122,720; in England Sept. 21, 1896, No. 20,903; in France Nov. 16, 1896, No. 258,473; in Spain Nov. 20, 1896, No. 19,464; in Austria Nov. 28, 1896, No. 46/6,777; in Hungary Jan. 2, 1897, No. 7,441; in Switzerland Jan. 31, 1897, No. 12,804, and in Portugal Feb. 20, 1897, No. 29.

610,150. Apparatus for Generating Acetylene Gas. Max Strakosch, Vienna, Austria-Hungary. Filed Apr. 7, 1898. Serial No. 676,768.

610,159. Carbureter. Robert G. Speer, St. Louis, Mo. Filed Aug. 30, 1897. Serial No. 650,048.

Sept. 6.

610,171. Carbid-Cartridge for Acetylene Gas. Edward N. Dickerson, New York, N. Y. Filed June 16, 1897. Serial No. 640,981.

610,263. Gas-Burner. Albert L. Dowell, Paterson, N. J., assignor of one-half to Jew Garlick, same place. Filed Feb. 28, 1898. Serial No. 672,001.

610,281. Automatic Water-Heater. Edwin Ruud, East Pittsburg, Pa. Filed Jan. 22, 1897. Serial No. 620,196.

610,283. Incandescent Gas-Burner. Paul G. de Schodt, Namur, Belgium. Filed Oct. 19, 1897. Serial No. 655,704.

610,306. Acetylene-Gas Generator. William A. McCune, Sterling, Ill. Filed Sept. 14, 1897. Serial No. 651,672.

610,343. Means for Automatically Controlling Supply of Gas and Water, Etc. John S. Coe, Paterson, N. J., assignor to the Supreme Water Heater Company, of New Jersey. Filed Jan. 4, 1898. Serial No. 665,557.

610,414. Gas-Burner. Frank Rhind, Bridgeport, Conn., assignor of one-half to The Bridgeport Brass Company, same place. Filed Nov. 6, 1897. Serial No. 657,643.

610,473. Welsbach Lamp. Frank A. Cortis, Meriden, Conn., assignor of one-half to Dwight T. Cortis, Boston, Mass. Filed Oct. 27, 1896. Serial No. 610,174.

September 13.

610,623. Automatic Cut-Off for Gas-Burners. Phillip C. Folwell, Toronto, Canada. Filed Oct. 9, 1897. Serial No. 654,719.

610,682. Gas-Engine. Joseph N. Kelly and Wallace M. Kelch, Dayton, Ohio. Filed Mar. 31, 1897. Serial No. 630,065.

610,867. Process of and Apparatus for Making Hydrogen Gas and Other Products. Leopoldo V. Pratis and Pietro Marengo, Turin, Italy. Filed July 15, 1897. Serial No. 644,701. Patented in England July 22, 1896, No. 16,277, and June 29, 1897, No. 15,509; in Italy Jan. 26, 1897, No. 43,205; in Belgium Feb. 27, 1897, No. 126,377; in Luxemburg Mar. 12, 1897, No. 2,783, and in Spain Mar. 29, 1897, No. 20,497.

610,868. Utilizing Hydrogen Gas for Producing Light and Heat. Leopoldo V. Pratis, and Pietro Marengo, Turin, Italy. Filed July 15, 1897. Serial No. 644,702. Patented in England July 22, 1896, No. 16,277A; in Italy Jan. 26, 1897, No. 43,205; in Belgium Feb. 27, 1897, No. 126,377; in Luxemburg Mar. 12, 1897, No. 2,783, and in Spain Mar. 29, 1897, No. 20,497.

610,869. Gas-Motor. Leopoldi V. Pratis and Pietro Marengo, Turin, Italy. Filed July 15, 1897. Serial No. 644,703.

610,877. Acetylene-Gas Generator. Matthias F. McNelly, Chicago, Ill., assignor to the Monarch Manufacturing Company, Indianapolis, Ind. Filed Oct. 30, 1897. Serial No. 656,876.

September 20.

610,937. Acetylene-Gas Generator. Brank E. Bundy, Elmira, N. Y. Filed Sept 2, 1897. Serial No. 650,321.

610,994. Apparatus for Making Gas from Oil. Francis L. Martenette, Chico, Cal. Filed Feb. 9, 1898. Serial No. 669,668.

611,002. Acetylene-Gas Generator. Richard Pintsch, Berlin, Germany, assignor to the Safety Car Heating and Lighting Company, New York, N. Y. Filed Oct. 30, 1896. Serial No. 610,542. Patented in Switzerland Sept. 19, 1896, No. 12,865, and in England Oct. 31, 1896, No. 20,602.

611,081. Method of and Apparatus for Collecting and Purifying Gas. Joseph Schneible, New York, N. Y. Filed June 11, 1895. Renewed Feb. 10, 1898. Serial No. 669,864.

611,125. Gas or Oil Motor Engine. Herbert A. Humphrey, Northwich, England. Filed Nov. 30, 1897. Serial No. 660,261. Patented in England Jan. 5, 1895, No. 347.

611,168. Automatic Gas-Supply Apparatus. Edward N. Dickerson, New York, N. Y. Filed Dec. 20, 1894. Serial No. 532,425. Patented in England June 18, 1895, No. 11,848B; in France June 18, 1895, No. 248,270; in Belgium June 18, 1895, No. 116,130; in Italy June 18, 1895, XXX, 39, 163, LXXVI, 430, and in Spain June 19, 1895, No. 17,594.

Sept 27.

611,248. Gas-Burner. James C. Gray and Thomas Roderick, Columbus, Ohio, said Roderick assignor to said Gray. Filed Oct. 30, 1897. Serial No. 656,918.

611,341. Mixer and Vaporizer for Explosive-Engines. Geo. W. Starr and John H. Cogswell, Havana, Ill. Filed Aug. 10, 1897. Serial No. 647,730.

611,348. Igniting Device for Gas-Engines. William A. Bole and Thomas J. Hogan, Pittsburg, Pa. Filed June 30, 1897. Serial No. 646,463.

611,425. Means for Automatic Control of Gas-Supply in Gas Cooking-Stoves. John Wynn, Cardiff, England. Filed Feb. 2, 1897. Serial No. 621,675. Patented in England Sept. 23, 1896, No. 21,050; in France Jan. 9, 1897, No. 262,924; in Belgium Jan. 11, 1897, No. 125,674; in Canada Feb. 24, 1897, No. 55,093; in South Australia Mar. 2, 1897; No. 3,575; in Victoria Mar. 3, 1897, No. 13,987; in New South Wales Mar. 5, 1897, No. 7,306; in Queensland Mar. 6, 1897, No. 3,777, in Tasmania Mar. 8, 1897, No. 1,842; in West Australia Nov. 30, 1897, No. 1,883, and in New Zealand Dec. 3, 1897, No. 10,180.

611,471. Regulator for Gas-Burners. Robert Gilchrist, Louisville, Ky. Filed Nov. 18, 1897. Serial No. 659,133.

611,473. Method of and Apparatus for Generating Acetylene Gas. Clarence R. Gillett, Chicago, Ill., assignor to Henry W. Leman, same place. Filed Aug. 26, 1898. Serial No. 689,543.

611,483. Acetylene-Gas Generator. George L. Hogan, Baltimore, Md. Serial No. 677,442.

611,490. Gas-Generator. Henry Keller, New York, N. Y., assignor of one-half to Albert A. Meyer, same place. Filed Mar. 19, 1897. Serial No. 628,243.

611,519. Gas Regulator. John F. Simmance, London, England. Filed Dec. 24, 1897. Serial No. 663,363.

611,527. Incandescent Mantle Support. Leopold Stiassny, New York, N. Y. Filed Feb. 24, 1898. Serial No. 671,514.

611,577. Acetylene-Gas Generator. Alvah M. Griffin, Marysville, Kan., assignor to the Griffin Gas Company, same place, Filed Oct. 9, 1897. Serial No. 654,684.

UNITED STATES PATENTS RELATING TO GAS.

Expired from October 1st, 1897, to October 1st, 1898.

October 5, 1880.

232,808. Gas-Engine. Louis Durand, Quebec, Province of Quebec, Canada, assignor of one-half of his right to Dexter H. Walker, New York, N. Y. Filed May 19, 1880.

232,937. Pipe Cutter and Wrench. Genry A. Chapman, Strawberry Point, Iowa. Filed Aug. 21, 1880.

232,943. Gas Regulator. James Blatch Cox, 13 Strand, Torquay, England. Filed Mar. 3, 1880. Patented in England, Sept. 18, 1879.

232,987. Gas-Engine. Charles Linford, Leicester, England. Filed Sept. 3, 1880. Patented in England Apr. 17, 1879 and Jan. 24, 1880.

233,048. Gas-Regulator. Joseph B. Tiffany, New York, N. Y. Filed Jan. 12, 1880.

October 12.

233,065. Gas or Vapor Burner. Charles F. Burnap, Allegheny, assignor to Ralph Bagaley, Pittsburgh, Pa. Filed July 10, 1880.

233,212. Hydrocarbon-Burner. John W. Culmer, Allegheny, assignor to the Culmer Manufacturing Company, Oil City, Pa. Filed May 31, 1880.

233,283. Gas-Stove. Antonio L. Rossetti, New York, assignor of one-half of his right to Orazio Lugo, Flushing, N. Y. Filed Apr. 10, 1880.

October 19.

233,370. Packing for Gas-Engines and Pipes. Julius Pintsch, Berlin, Prussia. Filed July 9, 1880. Patented in Germany Sept. 4, 1877.

233,372. Ventilating Gasalier. John P. Putnam, Boston, Mass. Filed July 19, 1880.

233,389. Gas-Stove. James Adams, Glasgow, Great Britain. Filed Dec. 5, 1879. Patented in England, Mar. 19, 1879.

233,451. Gas-Governor. John A. Wilson, Baltimore, Md. Filed Apr. 29, 1880.

October 26.

233,609. Gas-Burner. Joseph S. Ford, Philadelphia, Pa. Filed Aug. 3, 1880.

233,645. Gas-Meter. Lafayette L. Treman, Ithaca, N. Y. Filed Apr. 23, 1880.

233,804. Gas-Engine. Alexander K. Rider, Walden, assignor to T. J. Rider, New York, N. Y. Filed May 31, 1880.

November 2.

233,860. Process of and Apparatus for Generating Gas. Erazm J. Jerzmanowski, New York, N. Y. Filed May 28, 1880.

233,862. Process of and Apparatus for Making Illuminating-Gas. Erazm J. Jerzmanowski, New York, N. Y. Filed May 28, 1880.

233,863. Cooking-Stove. Lazard Kahn, Cleveland, Ohio. Filed Apr. 5, 1880.

233,956. Gas Generator. Theophilus Van Kannel, Cincinnati, Ohio. Filed Dec. 31, 1879.

233,978. Carbureting Apparatus. George H. Burrows, Somerville, Mass. Filed June 18, 1879.

234,108. Carbureting Apparatus. John Ruthven, St. Louis, Mo. Filed Oct. 14, 1879.

November 9.

234,198. Gas-Apparatus. John C. Noonan and George W. Young, Philadelphia, Pa. Filed Oct. 29, 1879.

234,282. Hydrocarbon-Burner. John S. Hull, Baltimore, Md. Filed May 6, 1880.

234,358. Indicating Time by Gas-Pressure. Gustavus G. Wagner, New York, N. Y. Filed Apr. 7, 1880.

November 16.

234,395. Hydrocarbon Furnace. William D. Dickey, New York, N. Y. Filed Sept. 1, 1880.

234,400. Process of and Apparatus for Manufacturing Illuminating Gas. Arthur O. Granger and Joseph H. Collins, Jr., Philadelphia, Pa. Filed Apr. 12, 1880.

234,421. Gas-Pressure Regulator. Person Noyes, Lowell, Mass. Filed Mar. 19, 1879.

234,468. Hydrocarbon-Burner. Daniel M. Graham, Chicago, Ill. Filed July 3, 1880.

234,546. Gas-Making Apparatus. Charles F. Dieterich, Baltimore, Md. Filed Dec. 12, 1879.

November 23.

234,662. Apparatus for Lighting Gas by Electricity. Edward N. Dickerson, Jr., New York, N. Y. Filed July 23, 1880.

November 30.

234,898. Fluid-Meter. Daniel P. Weir, Salem, Mass., assignor of one-half to John Jackson, same place. Filed May 15, 1880.

234,955. Carbureting Apparatus. George H. Burrows, Boston, Mass. Filed Jan. 8, 1880.

235,024. Electric Gas-Lighting Burner. David Rousseau, New York, N. Y. Filed July 28, 1880.

December 14.

235,415. Vapor-Burner for Stoves. Zebulon Davis, Canton, Ohio, assignor to William B. Blake, same place. Filed Aug. 27, 1880.

235,451. Apparatus for Generating Hydrocarbon Illuminating and Heating Gas. William P. Patton, Harrisburg, Pa., assignor of one-half to John Hervey Patton, same place. Filed June 26, 1880.

235,545. Indicator for Gas-Burners. John Manuel, Philadelphia, Pa. Filed May 5, 1880.

December 21.

235,621. Hydrocarbon-Burner. Frederick W. Carter, Camden, N. J. Filed Sept. 27, 1880.

235,640. Gas Stove or Oven. Albanus W. Morton, Brooklyn, assignor to Morton Gas Stove Company, New York, N. Y. Filed Mar. 19, 1880.

235,646. Pump for Compressing Illuminating Gas. Richard J. Pintsch and Julius Pintsch, Berlin, Germany. Filed Oct. 12, 1880.

235,769. Electric Lighting Attachment for Gas-Burners. Charles H. Hinds, New York, N. Y. Filed Apr. 7, 1880.

December 28.

235,978. Electric Lighting Device. George D. Bancroft, Boston, Mass. Filed June 7, 1880.

235,979. Electric Gas-Lighting Apparatus. George D. Bancroft, Boston, Mass. Filed Apr. 23, 1880.

236,010. Apparatus for Lighting and Extinguishing Gas-Burners by Automatic Means. Wilhelm Effer, Berlin, Germany. Filed Aug. 26, 1880. Patented in England May 10, 1880.

236,039. Process of and Apparatus for Manufacturing Gas. Moses W. Kidder, Lincoln, Mass. Filed Jan. 12, 1880.

236,098. Hydrocarbon-Furnace. Byron Sloper, New York, N. Y., assignor of one-half to Walter M. Jackson, Providence, R. I. Filed Nov. 16, 1880.

January 4, 1881.

236,208. Hydrocarbon-Furnace for the Production of Steam, Reduction of ores, Etc. Virgil W. Blanchard, Weybridge, Vt. Filed July 24, 1879.

236,258. Oscillating Gas-Motor. Joseph Ravel, Paris, assignor to Compagnie des Moteurs à Gaz Français, Système Ravel, France. Filed Oct. 26, 1880. Patented in France Nov. 23, 1878.

January 11.

236,411. Generator for Hydrocarbon-Engines. Israel R. Blumenberg, Washington D. C. Filed Oct. 9, 1880.

236,433. Carbureter. John W. Hoard, Providence, R. I. Filed Sept. 16, 1880.

236,480. Compound for Manufacture of Gas-Tubing. Samuel Barr, Providence, R. I. Filed Dec. 3, 1879.

236,491. Apparatus for the Manufacture of Heating and Illuminating Gases. William Harkness, New York, N. Y. Filed Feb. 2, 1880.

236,551. Gas-Regulating Burner. John N. Chamberlain, Springfield, Mass. Filed May 3, 1880.

236,586. Carbureting Apparatus. Abel Henning, Easton, Md. Filed June 2, 1880.

236,622. Pumping Mechanism for Gas Apparatus. S. Henry Pincus, Philadelphia, Pa. Filed Mar. 23, 1880.

January 18.

236,665. Stove. Ebenezer Blackman, Brooklyn, N. Y. Filed Apr. 6, 1880.

January 25.

236,869. Apparatus for Obtaining Heat from Gas. Augustus L. Allen and Geo. W. Harris, Poughkeepsie, assignors of one-third to Horatio P. Allen, New York, N. Y. Filed Oct. 29, 1880.

236,999. Gas-Retort Lid. William J. Dooley, New York, N. Y. Filed June 3, 1880.

237,034. Gas-Regulator. Jacob Merritt, and Archibald Ford. San Francisco, Cal. Filed Nov. 4, 1880.

February 8.

237,541. Process of and Apparatus for Manufacturing Gas. Jas. J. Johnston, Columbiana, Ohio, assignor to himself and A. C. Ellis, Allegheny, Pa. Filed Sept. 17, 1880.

237,542. Gas-Scrubber. Edward Jones, South Boston, Mass. Filed July 31, 1880.

237,663. Hydrocarbon-Gas Generator. Joseph Flannery, Philadelphia, Pa. Filed May 6, 1880.

February 15.

237,672. Gas or Vapor Stove. John Benbow, Cleveland, Ohio. Filed July 9, 1880.

237,752. Gas-Carbureter. Peter Keller, New York, N. Y., assignor to the Gas Carburetter and Economizing Company, same place. Filed Aug. 17, 1880.

237,869. Radiator. Charles B. Hotchkiss, Brooklyn, N. Y. Filed Dec. 27, 1879.

237,898. Apparatus for Making Illuminating-Gas. Julius Pintsch, Berlin Prussia, Germany. Filed July 9, 1880. Patented in Germany July 3, 1877.

February 22.

238,020. Apparatus for Producing Illuminating Gas or Vapor. Samuel J. Anthony and Edward J. Frost, Philadelphia, Pa. Filed May 15, 1880.

238,141. Carbureter. William McKenzie and James H. Mason, Detroit, Mich., assignors to the Combination Gas Machine Company, same place. Filed Sept. 28, 1880.

238,169. Self-Extinguishing Gas-Burner. Nathaniel Sleeman, Ansonia, assignor of one-half to Lewis Hotchkiss, Birmingham, Conn. Filed Sept. 20, 1880.

March 1.

238,205. Gas-Burner. John F. Barker, Springfield, Mass. Filed Dec. 29, 1880.

238,301. Burner for Gas-Stoves. Albanus W. Morton, Brooklyn, N. Y. Filed June 5, 1880.

238,359. Gas-Governor. William Cowan, Edinburgh, North Britain. Filed Jan. 13, 1881. Patented in England Dec. 8, 1880.

238,375. Gas-Regulator. John M. Foster, Philadelphia, Pa. Filed Oct. 23, 1880.

238,377. Automatic Gas Lighting and Extinguishing Device. John M. Foster, Philadelphia, Pa. Filed Aug. 11, 1880.

238,383. Electrical Gas Lighter. Charles D. P. Gibson, New York, N. Y. Filed Sept. 28, 1880.

283,386. Carbureter. James T. Guthrie, Leesburg, Ohio. Filed Oct. 2, 1880.

238,411. Door-Frame for Retort-Benches of Gas-Works. Albien H. Lowell, Manchester, N. H. Filed Nov. 2, 1878.

238,435. Gas-Regulating Burner. Hannibal W. Rappleye, Philadelphia, Pa. Filed Jan. 8, 1881.

9,595 (Re-issue). Manufacture of Illuminating-Gas. Asa W. Wilkinson, New York, N. Y. Filed Mar. 31, 1880. Original No. 123,538, dated Feb. 6, 1872; Reissue No. 4,821, dated Mar. 19, 1872; Reissue No. 5,149, dated Nov. 19, 1872.

March 8.

238,633. Vapor-Burner. George W. Billings, Cleveland, Ohio, assignor to Otis D. Crocker, same place. Filed May 24, 1880.

238,634. Vapor-Burner. George W. Billings, Cleveland, Ohio, assignor to Otis D. Crocker, same place. Filed July 26, 1880.

238,668. Hydrocarbon-Gas Generator. Peter J. Fitzgerald, Sharon Hill, assignor of one-half to C. F. Robertson, Philadelphia, Pa. Filed Nov. 12, 1880.

March 15.

238,757. Carbureter. Adelbert M. Brainard, Chicago, Ill., assignor of one-half to Alonzo Pelton, same place. Filed May 17, 1880.

238,768. Gas-Valve. Julius C. Drucklieb and William Fels, Paterson, N. J. Filed Dec. 7, 1880.

238,818. Carbureter. William W. Walmsley, San Francisco, Cal. Filed Dec. 30, 1880.

238,837. Gas-Making Apparatus. John W. Boland, Baltimore, Md. Filed July 28, 1880.

238,984. Gas or Vapor Stove. John Swarts, New York, N. Y. Filed Dec. 17, 1880.

March 22.

239,014. Combined Fire-Alarm and Gas-Lighting Apparatus. George D. Bancroft, Boston, Mass. Filed Dec. 8, 1880.

239,282. Gas-Meter. Thomas Tansley, Jr., Baltimore, Md., assignor to Dickey, Tansley & Co., same place. Filed Jan. 24, 1881.

9,611 (Reissue). Apparatus for Lighting Gas by Electricity. Edward N. Dickerson, New York, N. Y., assignee, by mesne assignments, of Samuel Gardner, Jr., deceased. Filed Jan. 29, 1881. Original No. 62,125, dated Feb. 19, 1867.

April 5.

239,706. Hydrocarbon Furnace. Virgil W. Blanchard, Weybridge, Vt. Filed Mar. 19, 1880.

239,856. Apparatus for Automatically Igniting, Extinguishing, and Regulating Gas-Lights. Julius Schülke, Berlin, Prussia, Germany. Filed Dec. 16, 1880. Patented in Germany Apr. 9, 1880.

239,870. Apparatus for the Manufacture of Gas. R. H. Smith, Pittsburg, Pa. Filed Oct. 23, 1880.

239,871. Gas-Governor. Roland H. Smith, Pittsburg, Pa. Filed Oct. 23, 1880.

April 12.

239,988. Automatic Safety-Reservoir for Hydrocarbon-Burners. Morrill A. Shepard, Lebanon, Ill. Filed Jan. 17, 1881.

240,165. Gas-Generating Furnace. Rudolf Müller, Berlin, Germany. Filed Apr. 1, 1880.

April 19.

240,298. Street and Other Lamps. Geo. Bray, Leeds, County of York, England. Filed July 21, 1880. Patented in England Apr. 12, 1879 and Aug. 19, 1879.

April 26.

240,592. Hydrocarbon Furnace. Joshua A. Houchin and Joshua R. Houchin, Brooklyn, assignors to the Hydrocarbon Furnace Company, New York. N. Y. Filed July 31, 1880.

240,644. Hydrocarbon Furnace. Jonathan Bell, New York, N. Y. Filed Sept. 25, 1880.

240,661. Apparatus for Lighting Gas by Electricity. Chas. L. Clarke and Jno. Leigh, Manchester, County of Lancaster, Great Britain. Filed Feb. 14, 1881. Patented in England June 1, 1880.

240,672. Front Wall of Gas-Retort Ovens. Darius Davison, New York, N. Y. Filed Sept. 17, 1878.

240,699. Electric Gas-Lighting and Extinguishing Apparatus. Robert Haase, Indianapolis, Ind. Filed Feb. 11, 1881.

May 3.

240,994. Gas-Engines. Charles J. B. Gaume, Brooklyn, N. Y. Filed Jan. 19, 1881.

241,057. Gas-Pressure Regulator. Person Noyes, Lowell, Mass. Filed Apr. 19, 1880.

241,109. Apparatus for Heating Retort Benches in the Manufacture of Gas. Asa W. Wilkinson, New York, N. Y. Filed Aug. 17, 1880.

May 10.

241,115. Electric Gas-Lighting Apparatus. Osmon S. Armstrong, Cambridge, Mass. Filed Aug. 17, 1880.

241,134. GAS-APPARATUS. Arthur O. Granger and Joseph H. Collins, Jr., Philadelphia, Pa. Filed Apr. 22, 1880.

241,197. GAS-BURNER CLEANER. Juan Bellido DeLuna, New York, N. Y. Filed Mar. 24, 1881.

241,208. APPARATUS FOR THE COMBUSTION OF GASES AND VAPORS. Joseph P. Gill, New York, N. Y. Filed Feb. 28, 1881.

241,419. APPARATUS FOR OBTAINING AN ILLUMINATING AND HEATING GAS. Edward B. Reynolds, Cleveland, Ohio. Filed Feb. 3, 1881.

May 17.

241,706. GAS-MOTOR ENGINE. Nicolaus A. Otto, Deutz-on-the-Rhine, Germany. Filed Mar. 28, 1881. Patented in England Jan. 5, 1881.

241,707. GAS-MOTOR ENGINE. Nicolaus A. Otto, Deutz-on-the-Rhine, Germany. Filed Mar. 28, 1881. Patented in England Jan. 5, 1881.

9,709 (Re-issue). LIGHTING GAS BY ELECTRICITY. Edward N. Dickerson, Jr., New York, N. Y., assignee, by mesne assignments, of Samuel Gardner, Jr., deceased. Filed Feb. 7, 1881. Original No. 55,641, dated June 19, 1866.

May 24.

241,779. GAS-LIGHTING DEVICE. William M. Batchelder, New York, N. Y. Filed Mar. 8, 1881.

241,798. GAS-LIGHTING TORCH. Elliott P. Gleason, Brooklyn, N. Y. Filed Jan. 11, 1881.

241,950. HYDROCARBON-GAS APPARATUS. Peter J. Fitzgerald, Philadelphia, Pa., assignor of one-half to Charles F. Robertson, same place. Filed Mar. 11, 1881.

May 31.

242,102. BLAST-FURNACE. James C. Bennett, Chicago, Ill. Filed Oct. 14, 1878.

242,103. BLAST-FURNACE. James C. Bennett, Chicago, Ill. Filed Nov. 20, 1880.

242,132. GAS-LIGHTER. John H. Hutchison, Logansport, Ind. Filed Mar. 28, 1881.

242,222. LIGHTING GAS BY ELECTRICITY. Thomas H. Rhodes, Brooklyn, N. Y. Filed Apr. 20, 1881.

242,260. GAS-PRESSURE RECORDER. Ernest Brouardel, Paris, France. Filed Mar. 18, 1881. Patented in France Oct. 16, 1879.

242,401. GAS-ENGINE. George Wacker, New York, N. Y., assignor to himself and John J. Jungermann, same place. Filed Apr. 1, 1881.

June 7.

242,546. Process of Manufacturing and Purifying Gas for Preserving Purposes. Charles T. Lawton, Arthur W. Lawton and Albert L. Lawton, Rochester, N. Y. Filed Dec. 6, 1880.

242,547. Gas-Generating Furnace. Georg Liegel, Stralsund, Prussia, Germany, assignor to William Eppelsheimer and Henry J. Huttner, both of San Francisco, Cal. Filed Jan. 6, 1881.

242,555. Gas-Regulator. Julius Pintsch, Berlin, Prussia, Germany. Filed Mar. 30, 1881. Patented in Germany, Sept. 4, 1877 and Sept. 19, 1878.

242,693. Electric Gas-Lighting. Jerome Redding, Malden, assignor to himself and Harvey Redding, Everett, Mass. Filed Feb. 21, 1881.

June 14.

243,046. Apparatus for the Manufacture of Gas. Andrew Hickenlooper, Cincinnati, Ohio. Filed Oct. 21, 1880.

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243,066. Furnace for Generating Heating-Gas. William Gardner and John H. McElroy, Pittsburg, Pa. Filed Feb. 3, 1881.

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243,344. Electric Gas-Lighting Burner. Adam Lüngen, New York, N. Y., assignor of one-half to Robert Edwards, same place. Filed Mar. 24, 1881.

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243,472. Furnace for Burning Hydrocarbons. Wm. W. Thomas, Jersey City, N. J., assignor to Samuel T. Thomas, Philadelphia, Pa. Filed Mar. 22. 1881.

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244,170. Manufacture of Gas Tubing. Samuel Barr, Providence, R. I. Filed Apr. 8, 1881.

244,173. Apparatus for Making Gas. Wm. Bell, New York, N. Y. and Andrew B. Lipsey, West Hoboken, N. J., said Lipsey assignor to said Bell. Filed Feb. 1, 1881.

244,174. Apparatus for Making Gas. William Bell, New York, N. Y. and Andrew B. Lipsey, West Hoboken, N. J., said Lipsey assignor to said Bell. Filed Jan. 19, 1881.

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244,387. Apparatus for Carbureting Gas or Air. John W. Hoard, and Frederick W. Hoard, Providence, R. I. and Geo. B. Wiggin, Louth New Market, N. H. Filed Apr. 19, 1881.

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245,218. Gas-Engine. Alexander K. Rider, Waldon, assignor to Thomas J. Rider, New York, N. Y. Filed May 12, 1881.

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245,545. Electric Gas-Lighting Device. George M. Murdoch, Binghamton, N. Y. Filed June 24, 1881.

245,579. Gas-Regulator. William T. Sugg, Westminster, England. Filed Mar. 31, 1881. Patented in England May 6, 1880.

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245,767. Hydraulic Main for Gas Apparatus. Wm. R. Beal, New York, N. Y. Filed Apr. 11, 1881.

245,799. Electrical Gas-Lighting Apparatus. Wm. A. Drysdale, Philadelphia, Pa. Filed May 6, 1881.

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245,981. Carbureted-Gas Regulator. Chas. W. Soule, Boston, Mass. Filed May 31, 1881.

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NEW PUBLICATIONS.

THE CALORIFIC POWER OF FUELS. By Herman Poole, F.C.S. New York: John Wiley & Sons. Price, $3.00.

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PRACTICAL GAS-FITTING. By J. W. Hughes and W. B. Gray. Octavo (5.5x8); boards; dark red cloth; 116 pages; 54 illustrations. New York, 1896: David Williams, pub. $1.00.

THE GAS ENGINEER'S POCKET BOOK. By H. O'Connor, Assoc. M.I.C.E., Vice-Pres. Soc. of Engineers, London. Small octavo; Published in London, 1898. American Edition by D. Van Nostrand Company, New York. $3.50.

TEXT-BOOK OF PHYSICAL CHEMISTRY. By Clarence L. Speyers, Assoc. Prof. of Chem., Rutgers College. Large 12mo., 224 pages. 1897: D. Van Nostrand Company, New York. Price, $2.25.

EXCERPTS FROM DECISIONS OF THE BOARD OF GAS COMMISSIONERS OF THE COMMONWEALTH OF MASSACHUSETTS. Compiled by E. H. Yorke. Large 16mo pamphlet, 28 pages. Portland, Me., 1898: Stephen Berry, pub. $1.00.

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Chairman of Massachusetts Board of Gas and Electric Light Commissioners, Boston, Mass., State House, Room 145.

Chandler, C. F. October 21, 1875.
41 East 49th street, New York, N. Y., Dean, Columbia College School of Mines.

Foote, Allen R. October 17, 1894.
Tacoma Park, D. C.

Greenough, William W. October 16, 1878.
299 Marlborough street, Boston, Mass.

King, William. October 18, 1877.
Duke street, Liverpool, England, Engineer of Liverpool United Gas Light Co.

Livesey, George T. October 20, 1897.
M.I.C.E., etc., Chairman South Metropolitan Gas Company, Old Kent Road, London, England.

Love, E. G. October 20, 1886.
122 Bowery, New York, N. Y., Gas Examiner, Department Public Works, of New York City.

Morton, Henry. October 18, 1878.
Hoboken, N. J., President of Stevens Institute of Technology.

Woodall, Corbet. October 20, 1897.
M. I. C. E., etc., Palace Chambers, Westminster, London, England.

ACTIVE MEMBERS.

Abel, W. G. October 20, 1886.
42 West Baker street, Atlanta, Ga., P. O. Box 311, Engineer of Atlanta Gas Light Co.

Adams, Charles F. October 17, 1894.
5th and Yawhill streets, Portland, Oregon, P. O. Box 73, President of Portland Gas Co.

Adams, Harry C. October 20, 1886.
224 South Third street, Philadelphia, Pa., P. O. Box 1322, Vice-President of Westmoreland Coal Co.

Addicks, J. Edward. October 20, 1886.
1500 Market street, Philadelphia, Pa.

Addicks, Frederick P. October 15, 1890.
24 West street, Boston, Mass., Treasurer of Boston Gas Light and Bay State Gas Co's.

Addicks, Walter R. October 15, 1890.
24 West street, Boston, Mass., Chief Engineer of Boston, Bay State and Brookline Gas Co's.

Africa, Walter G. October 21, 1891.
46 Hanover street, Manchester, N. H., Treasurer and Superintendent of People's Gas Light Co.

Aldrich, W. A. October 19, 1898.
Spokane Falls, Washington, Secretary Spokane Falls Gas Light Company.

Andrews, J. Charles. October 19, 1898.
19th and Allegheny avenues, Philadelphia, Pa., Superintendent of Meters United Gas Improvement Co., Philadelphia Gas Works.

Archer, Benjamin F. October 16, 1879.
319 Cooper street, Camden, N. J., President of Camden Gas Light Co.

Armington, James H. October 19, 1881.
Riverside, R. I., P. O. Box 41.

Armington, William A. October 19, 1892.
256 West 23d street, New York, N. Y., Manager De Lery Light Co.

Bailey, William. October 19, 1898.
Oskaloosa, Iowa, Secretary and Manager Oskaloosa Gas Co.

Barret, A. H. October 16, 1878.
Sixth and Green streets, Louisville, Ky., Engineer Louisville Gas Company.

Barrett, W. E. October 16, 1895.
Linwood avenue, Ardmore, Pa., P. O. Box 77, Superintendent and Secretary of the Lower Merion Gas Co.

Bartlett, Edward L. October 20, 1886.
McHenry and Scott streets, Baltimore, Md., P. O. Box 960, Mechanical Engineer of Bartlett, Hayward & Co.

Battin, H. S. October 19, 1898.
4257 Frankford avenue, Philadelphia, Pa., District Superintendent (Distribution) United Gas Improvement Co.

Battin, Isaac. October 15, 1873.
1224 Farnam street, Omaha, Neb., Treasurer and Engineer of the Omaha Gas Manufacturing Co.

Baumgardner, John H. October 15, 1879.
129 North Queen street, Lancaster, Pa., Secretary of Lancaster Gas Light and Fuel Co.

Baxter, Isaac C. October 18, 1882.
636 Trumbull avenue, Detroit, Mich., Vice-President and Treasurer of Windsor Gas Co., Windsor, Ontario.

Baxter, Robert. October 19, 1881.
Halifax, N. S., Manager of Halifax Gas Light Co., Limited.

Baxter, William H. April 16, 1873.
201 Sycamore street, Petersburg, Va., P. O. Box 34, Treasurer and Superintendent of Petersburg Gas Light Co.

Beadenkopf, George. October 21, 1891.
19 South street, Baltimore, Md., Assistant Engineer of Consolidated Gas Co.

Beadle, A. B. October 21, 1891.
813 Drexel building, Philadelphia, Pa., Inspecting Engineer with the United Gas Improvement Co.

Beal, Thaddeus R. October 21, 1891.
138th street and East River, New York, N. Y., Superintendent of Central Union Gas Co.

Beal, William R. May 13, 1874.
350 Alexander avenue, New York, N. Y., President and Engineer of Central Union Gas Co.

Benson, Fred. S. October 20, 1875.
Kent avenue, cor. of Cross street, Brooklyn, N. Y., Chief Engineer, Eastern Division of the Brooklyn Union Gas Co.

Betts, Edward. October 17, 1888.
827 Market street, Wilmington, Del., P. O. Box 999, President of Wilmington Coal Gas Co.

Bigelow, Arthur F. October 19, 1892.
540 Hamilton street, Allentown, Pa., Superintendent of Allentown Gas Co.

Bissell, West. October 20, 1897.
Jersey City, N. J., Assistant Superintendent United Gas Improvement Company, Jersey City, N. J.

Blodget, Charles W. October 15, 1884.
324 Bedford avenue, Brooklyn, E. D., N. Y., P. O. Box 23, Manager and Engineer of Williamsburgh Branch, Brooklyn Union Gas Co.

Boardman, Arthur E. October 15, 1884.
Brevard, N. C., President and Treasurer of Macon Gas Light and Water Co., Macon, Ga.

Boardman, A. J. October 27, 1896.
Roberts Building, Tampa, Fla., Manager of Tampa Gas Co.

Bodine, Samuel T. October 20, 1886.
813 Drexel Building, Philadelphia, Pa., 2d Vice-President and General Manager of the United Gas Improvement Co.

Bogert, W. Russell. October 19, 1892.
Bristol, R. I., P. O. Box 387, Treasurer of Bristol County Gas and Electric Company.

Boore, Louis A. October 19, 1898.
Niagara Falls, N. Y., Secretary Niagara Falls Gas Light Co.

Borgner, Cyrus. October 13, 1880.
23d street above Race, Philadelphia, Pa., Manufacturer of Fire Brick and Clay Retorts.

Bowen, William S. October 15, 1890.
Newport News, Va., Superintendent of Newport News Gas Company.

Bowes, M. October 20, 1897.
Raleigh, N. C., Superintendent Raleigh Gas Company.

Bradley, Fred L. October 16, 1889.
99th street and 2d avenue, New York, N. Y., Superintendent of 99th and 111th street Stations, Consolidated Gas Co.

Bradley, William H. May 12, 1875.
4 Irving place, New York, N. Y., Chief Engineer of Consolidated Gas Co.

Branch, A. H. October 19, 1892.
405 17th street, Denver, Col., P. O. Box 359, Treasurer and General Manager of Denver Consolidated Gas Co.

Bredel, Frederick. October 21, 1885.
118 Farwell avenue, Milwaukee, Wis., P. O. Box 235, Gas Engineer and Contractor.

Britton, John A. October 16, 1895.
N. W. cor. 13th and Clay streets, Oakland, Cal., Secretary and General Manager of Oakland Gas Light and Heat Co.

Brown, Ernest C. October 19, 1887.
280 Broadway, New York, N. Y., Editor of "Progressive Age."

Brown, Rezeau B. October 27, 1896.
222 South 3d street, Philadelphia, Pa., General Superintendent The American Gas Co.

Buck, H. M.
Peru, Indiana, Superintendent Peru American Gas Company.

Buckman, James. October 15, 1890.
S. E. cor. 8th and Green streets, Philadelphia, Pa., Manager Bristol Gas Light Co.

Burke, James E. October 16, 1895.
Princeton, N. J., P. O. Box 637, Secretary and Treasurer of Princeton Gas Light Co.

Burrage, Albert C. October 20, 1897.
24 West street, Boston, Mass., President Boston, Roxbury, Dorchester, South Boston and Bay State (of Mass.) Gas Light Companies.

Bush, John S. October 17, 1883.
1845 Vanderbilt avenue, New York, N. Y., President of Northern Gas Light Co., of New York City.

Bush, Robert W. October 19, 1892.
12th street and Gowanus Canal, Brooklyn, N. Y., Engineer of Metropolitan Works, Brooklyn Union Gas Co.

Butterworth, Irvin. October 16, 1889.
135 North Front street, Columbus, Ohio, President and General Manager of the Columbus Gas Co.

Byers, C. A. October 17, 1894.
Toledo, Ohio, Consulting Engineer of Bristol Gas Light Co.

Byrne, Thomas E. October 18, 1882.
Fifth and Hoyt streets, Brooklyn, N. Y., Engineer of the Citizens' Works, Brooklyn Union Gas Co.

Cabot, John. October 19, 1884.
553 West 33d street, New York, N. Y., Manufacturer of Trays for Gas Works.

Callahan, W. P. October 19, 1881.
901 East 3d street, Dayton, Ohio, Director of Dayton Gas Light and Coke Co.

Callender, Elbert P. October 17, 1894.
32 Pine street, New York, N. Y., Editor of American Gas Light Journal.

Capelle, George S. October 19, 1887.
827 Market street, Wilmington, Del., Vice-President of Wilmington Coal Gas Co.

Cardall, J. H. October 18, 1893.
Cor. Main and Mill streets, Memphis, Tenn., Superintendent of New Memphis Gas Co.

Carpender, William. October 27, 1896.
32 Pine street, New York, N. Y., President East Chester (N.Y.) Gas Light Co.

Carroll, Francis. October 16, 1889.
1643 Perdido street, New Orleans, La., P. O. Box 171, Manager of Works of New Orleans Gas Light Co.

Cartwright, William. April 16, 1873.
3413 Baring street, Philadelphia, Pa.

Cathels, Edmund. October 27, 1896.
Hamilton, Ont., Superintendent and Engineer of Hamilton Gas Light Co.

Cathels, Wm. M. October 19, 1898.
Brantford, Ont., Manager Brantford Gas Co., Ltd.

Chandler, W. G. October 19, 1898.
30 North Third street, Harrisburg, Pa., Agent and Superintendent The United Gas Improvement Company, Harrisburg Gas Works.

Chollar, Byron E. October 17, 1888.
411 North 11th street, St. Louis, Mo., Engineer of Laclede Gas Light Co.

Clahan, John J. October 19, 1898.
133 Whitney place, Buffalo, N. Y., Superintendent of People's Gas Light and Coke Company.

Clark, Walton. October 15, 1884.
813 Drexel Building, Philadelphia, Pa., General Superintendent of the United Gas Improvement Co.

Clarke, George S. October 17, 1888.
10th and Walnut streets, Kansas City, Mo., Superintendent of Kansas City, Missouri, Gas Company.

Clary, Edward D. October 21, 1891.
911 North 6th street, Burlington, Iowa, Secretary and Superintendent of Burlington Gas Light Co.

Clements, John. October 19, 1898.
Red Bluff, Cal., Secretary Red Bluff Electric Light and Gas Company.

Cline, W. B. October 19, 1898.
Los Angeles, California, President Los Angeles Lighting Co.

Coates, John R. October 17, 1894.
23 Sparks street, Ottawa, Ont., President and Engineer of Ottawa Gas Co.

Cocke, J. T. Bowdoin, October 20, 1897.
Athens, Ga., President Athens Gas Light Company.

Coffin, John A. October 20, 1886.
Duncan street, Gloucester, Mass., Superintendent and Agent of Gloucester Gas Light Co.

Coggshall, H. F. May 13, 1874.
316 Main street, Fitchburg, Mass., P. O. Box 633, General Manager and Treasurer of Fitchburg Gas and Electric Light Co.

Collins, Charles R. October 15, 1890.
216 Cherry street, Seattle, Wash., General Manager of Seattle Gas and Electric Light Company.

Collins, John. October 21, 1891.
1 Mt. William street, Port Jervis, N. Y., P. O. Box 972, Superintendent of Port Jervis Gas Co.

Corbett, Charles H. October 18, 1882.
428 Lafayette avenue, Brooklyn, N. Y., P. O. Station G, Vice-President of Continental Iron Works.

Cosgrove, W. L. October 20, 1886.
Alabama and Broad streets, Atlanta, Ga., P. O. Box 311, Secretary of Atlanta Gas Light Co.

Cowdery, Edward G. October 21, 1885.
Milwaukee and Michigan streets, Milwaukee, Wis., General Manager of Milwaukee Gas Light Co.

Cowing, John H. April 16, 1873.
186 Main street, Buffalo, N. Y., P. O. Drawer 262, General Manager Buffalo City Gas Co., Buffalo Gas Light Co. and Buffalo Mutual Gas Light Co.

Coyle, Patrick. October 19, 1881.
27 Arlington avenue, Charlestown, Mass., General Superintendent of Charlestown Gas and Electric Co.

Crafts, David W. October 20, 1875.
116 Main street, Northampton, Mass., P. O. Box 93, Superintendent of Northampton Gas Light Co.

Cressler, Alfred D. October 18, 1882.
Calhone and Murray streets, Fort Wayne, Ind., President of Kerr-Murray Manufacturing Co.

Crisfield, James A. P. October 15, 1890.
7 Congress street, west, Savannah, Ga., P. O. Box 315, Superintendent of Mutual Gas Light Co.

Crockett, Joseph B. October 17, 1883.
415 Post street, San Francisco, Cal., President and Engineer of San Francisco Gas and Electric Co.

Cross, Philip. October 19, 1898.
Syracuse, N. Y., General Manager of Syracuse Gas Co.

Croul, Jerome. October 21, 1891.
Lewis Block, Room 4, Detroit, Mich., Trustee of Detroit Gas Light Co.

Curley, Thomas. October 15, 1879.
827 Market street, Wilmington, Del., Superintendent of Wilmington Coal Gas Co.

Curtis, Samuel Philip. October 20, 1897.
Market Street Gas Works, Newark, N. J., Assistant Superintendent The Newark Gas Co.

Daly, David R. October 21, 1885.
Green and Essex streets, Jersey City, N. J., Vice-President and Treasurer of J. H. Gautier & Co.

Daniels, John M. October 15, 1890.
1344 Main street, Columbia, S. C., P. O. Box 152, Superintendent and Agent of the U. G. I. Co. for Columbia Gas Light Co.

Davis, Fred J. October 20, 1875.
74 Montgomery street, Boston, Mass., P. O. Box 1297, Constructing Engineer of Davis & Farnham Mfg. Co., Waltham, Mass.

Dawes, Beman G. October 19, 1898.
Newark, Ohio, President and Treasurer Newark Gas Light and Coke Co. and Lansing Gas Light Co.

Dell, John. October 21, 1885.
Room 916 Wainright Bldg., St. Louis, Mo., Traveling Agent of Laclede Fire Brick Manufacturing Co.

Diall, M. N. October 18, 1876.
507 Ohio street, Terre Haute, Ind., General Manager of Citizens' Gas & Fuel Co.

Dickey, Charles H. October 17, 1883.
North and Saratoga streets, Baltimore, Md., P. O. Box 773, General Manager Maryland Meter and Mfg. Co.

Dickey, Robert R. October 19, 1881.
Cor. Main and 2d streets, Dayton, Ohio, President of Dayton Gas Light and Coke Co.

Dingee, F. A. October 18, 1882.
720 Reading Terminal, Philadelphia, Pa., President of Pennsylvania Gas Coal Co.

Dixon, J. Alfred. October 19, 1892.
160 Broadway, New York, N. Y., Engineer of Pintsch Compressing Co.

Dixon, Robert M. October 15, 1890.
160 Broadway, New York, N. Y., Manager of Pintsch Compressing Co.

Doherty, Henry L. October 27, 1896.
Madison, Wis., General Manager of Madison Gas and Electric Co.

Dole, Walter S. October 27, 1896.
Cologne and Deering streets, Chicago, Ill., Superintendent South Station of People's Gas Light and Coke Company.

Donahue, E. J. October 19, 1898.
813 Drexel building, Philadelphia, Pa., Consulting Engineer Sioux Falls Gas Light Co., Sioux Falls, South Dakota.

Doty, Paul. October 27, 1896.
107 Ottawa street, Grand Rapids, Mich., Secretary, Treasurer and General Manager of Grand Rapids Gas Light Co.

Douglas, David. October 17, 1888.
Eau Claire, Wis.

Douglas, Henry W. October 21, 1891.
107 South 4th avenue, Ann Arbor, Mich., General Manager of Ann Arbor Gas Co.

Douthirt, W. F. October 19, 1898.
40 Wall street, New York, N. Y., Assistant Secretary Buffalo City Gas Company.

Dunbar, Carl H. October 18, 1893.
Elgin, Ill., P. O. Box 1987, Manager of Elgin American Gas Co.

Dunbar, James W. October 17, 1894.
Sycamore and 7th streets, New Albany, Ind., Superintendent of New Albany Gas Light and Coke Co.

Dunderdale, Thos. October 19, 1898.
23 Sparks street, Ottawa, Canada, Superintendent Ottawa Gas Company.

Dutton, Lewis R. October 19, 1898.
Wyncote, Pa., Superintendent The Jenkintown and Cheltenham Gas Company.

Eakin, John W. October 17, 1894.
709 Levee street, Cairo, Ill., Secretary and Superintendent of Cairo City Gas Co.

Edwards, George B. October 18, 1882.
113 Chambers street, New York, N. Y., Agent of Goodwin Meter Co.

Egner, Frederick. October 16, 1889.
26 Hamilton avenue, Norfolk, Va., Consulting Engineer.

Eichbaum, Frederick H. October 16, 1889.
2644 Howard street, San Francisco, Cal., Engineer and Superintendent of Pacific Gas Improvement Co.

Eilbeck, Arthur B. October 16, 1895.
Drexel Building, Philadelphia, Pa., General Manager Welsbach Commercial Co.

Elkins, George W. October 20, 1886.
423 Walnut street, Philadelphia, Pa., Manufacturer of Coal Tar Products.

Elkins, William L., Jr. October 23, 1886.
Land Title Building, Philadelphia, Pa., President and Vice-President of United Coke & Gas Co. and New England Gas & Coke Co.

Elliott, Walter P. October 16, 1895.
Chicopee, Mass., General Manager Chicopee Gas Light Co.

Evans, Charles H. October 16, 1889.
4133 Cottage Grove avenue, Chicago, Ill., Engineer and General Superintendent of Mutual Fuel Gas Co.

Faben, Charles R., Jr. October 21, 1885.
327 South Erie street, Toledo, Ohio, General Manager of Toledo Gas Light and Coke Company.

Faux, J. A. October 16, 1895.
62 Conestoga Building, Pittsburg, Pa.

Fay, William J. October 15, 1884.
Anaheim, Cal.

Ferrier, James. October 16, 1895.
315 12th street, Columbus, Ga., P. O. Box 372, Superintendent of the Gas Light Co. of Columbus.

Findlay, J. H. October 18, 1882.
17 Franklin street, Ogdensburg, N. Y., President of Malone Light, Heat, Power and Coal Co., Malone, N. Y.

Fitz, Robert F. October 15, 1890.
Elgin, Ill., Treasurer of Standard General Supply Co.

Flemming, Dudley D. October 13, 1880.
249 Washington street, Jersey City, N. J., Gas Engineer.

Floyd, Frederick W. October 18, 1882.
539 West 20th street, New York, N. Y., firm of James R. Floyd's Sons.

Floyd, Henry E. October 18, 1882.
539 West 20th street, New York, N. Y., firm of James R. Floyd's Sons.

Floyd, James R. April 16, 1873.
539 West 20th street, New York, N. Y.

Fodell, William P. October 15, 1879.
50 Laurel street, Philadelphia, Pa., Secretary and Treasurer of Northern Liberties Gas Co.

Fogarty, Thomas B. October 19, 1881.
300 South 11th street, Newark, N. J.

Forbes, James. October 16, 1889.
619 Cherry street, Chattanooga, Tenn., Superintendent of Chattanooga Gas Light Co.

Forstall, Alfred E. October 17, 1888.
Montclair, N. J., Secretary of the Trustees' Gas Educational Fund.

Forstall, Walton. October 16, 1895.
Broad and Arch streets, Ass't Engineer of Distribution Philadelphia Gas Works.

Foss, Eugene N. October 19, 1892.
8 Everett street, Jamaica Plain, Mass., President of Jamaica Plain Gas Light Co.

Fowler, John. October 15, 1879.
39 Laurel street, Philadelphia, Pa., Deily & Fowler, Laurel Iron Works.

Fowler, Samuel J. October 21, 1891.
Springfield, Mass., P. O. Box 1536, General Manager Springfield Gas Light Co.

Frost, William H. October 15, 1879.
11 East Wall street, Fort Scott, Kan., P. O. Box 463, President of Fort Scott Light and Fuel Co.

Fry, Charles C. October 17, 1883.
90 Exchange street, Lynn, Mass., Clerk, Treasurer and Director of Lynn Gas and Electric Co.

Gandey, A. C. October 21, 1891.
31 Bridge street, Lambertville, N. J., P. O. Box 217, Superintendent and Purchasing Agent of Lambertville Gas Light Co.

Gardner, James Jr. October 17, 1883.
335 5th avenue, Pittsburg, Pa., P. O. Box 373, Proprietor Lockport Retort and Fire Brick Works.

Gartley, Alonzo. October 19, 1898.
813 Drexel Building, Philadelphia, Pa., Consulting Engineer Johnstown and Gloversville Gas Co.

Gartley, William H. October 21, 1885.
Richmond and Tioga streets, Philadelphia, Pa., Engineer and Superintendent of Philadelphia Gas Improvement Co.

Gates, Frederick W. May 13, 1874.
17 Herkimer street, Hamilton, Ont., Can., President of Hamilton Gas Light Co.

Geggie, David H. October 19, 1881.
No. 2 Place d'Orleans, Quebec, Canada, P. O. Drawer 270, Secretary and Manager of the Quebec Gas Co.

Gerould, Charles L. October 17, 1883.
North Third and Prospect avenues, Mt. Vernon, N. Y., Superintendent of the East Chester Gas Light Co.

Gibbons, P. H. October 18, 1893.
407 Chestnut street, Coatesville, Pa., P. O. Box 108, Superintendent of Coatesville Gas Co.

Gibbs, W. W. October 20, 1886.
813 Drexel Building, Philadelphia, Pa., Chairman of Managing Committee, The United Gas Improvement Co.

Giblin, John A. October 21, 1891.
10 East Main street, Ilion, Herkimer Co., N. Y., P. O. Box 513, Superintendent Herkimer County Light and Power Co.

Gifford, Nathaniel W. October 21, 1891.
New Bedford, Mass., Superintendent of New Bedford Gas and Edison Light Co.

Gimper, John. October 15, 1890.
32d and Market streets, Galveston, Texas, Superintendent of Galveston Gas Co.

Glasgow, Arthur G. October 19, 1887.
9 Victoria street, London, S. W., England, Humphreys & Glasgow, London and New York.

Glass, Sheldon J. Oct. 20, 1897.
Montgomery Building, Milwaukee, Wis., Secretary and Treasurer Milwaukee Gas Light Co.

Goodwin, W. W. April 16, 1873.
Room A–655, Bourse Building, Philadelphia, Pa., President of Goodwin Meter Co.

Graf, Carl H. October 19, 1892.
185 Main street, Hackensack, N. J., Superintendent of Gas Department, Hackensack Gas and Electric Co.

Graves, Henry C. October 17, 1883.
Cor. Main and 2d streets, Dayton, Ohio, Vice-President of Dayton Gas Light and Coke Co.

Green, James. October 21, 1885.
915 Wainwright Building, St. Louis, Mo., President of Sedalia Gas Co., Moberly Gas and Electric Co., and Greencastle Gas and Electric Light Co.

Greenough, Malcolm S. October 16, 1878.
356 Superior street, Cleveland, Ohio, President Cleveland Gas Light and Coke Co.

Gribbel, John. October 17, 1883.
1513 Race street, Philadelphia, Pa., of John J. Griffin & Co., Meter Manufacturers.

Guldlin, Olaf N. October 21, 1891.
11 Webster street, Fort Wayne, Ind., President and Engineer of Western Gas Construction Co.

Gwynn, J. W. October 15, 1890.
Bucyrus, Ohio, P. O. Box 1092, Superintendent of Bucyrus Gas Light and Fuel Co.

Hadden, James M. October 19, 1898.
Poughkeepsie, N. Y., Manager Poughkeepsie Gas Works.

Hall, Arthur H. October 19, 1898.
350 Alexander avenue, New York, N. Y., Superintendent of Distribution Central Union Gas Co.

Hambleton, Francis H. October 17, 1888.
19 South street, Baltimore, Md., P. O. Box 288, Chief Engineer of Consolidated Gas Co.

Hammatt, Clarence S. October 15, 1890.
26 Main street, Jacksonville, Fla., Superintendent of Citizens' Gas and Electric Co.

Hanford, L. C. May 13, 1874.
1 Belden avenue, Norwalk, Conn., P. O. Box 402, Superintendent of Norwalk Gas Light Co.

Harbison, John P. May 13, 1874.
700 Main street, Hartford, Conn., Treasurer and General Manager Hartford City Gas Light Co.

Harper, George H. October 16, 1889.
2526 Broad avenue, Altoona, Pa., Superintendent Altoona Gas Co.

Harris, J. A. October 20, 1886.
1513 Race street, Philadelphia, Pa., with J. J. Griffin & Co., Gas Meter Manufacturers.

Hatstat, John W. October 27, 1896.
Hartford, Conn., Superintendent of Hartford City Gas Light Co.

Hauk, Charles D. October 21, 1885.
138 South 6th street, Philadelphia, Pa., Vice-President and General Manager of National Heat and Power Construction Co.

Hayward, Thomas J. October 15, 1884.
McHenry and Scott streets, Baltimore, Md., Bartlett, Hayward & Co., Engineers and Contractors.

Helme, William E. October 20, 1886.
1339 Cherry street, Philadelphia, Pa., Helme & McIlhenny, Meter Manufacturers.

Herron, J. T. October 15, 1890.
249 West Genesee street, Buffalo, N. Y., Superintendent of the Buffalo Gas Light Co.

Hickenlooper, Andrew. May 13, 1874.
838 Dayton street, Cincinnati, Ohio, P. O. Box 719, President of Cincinnati Gas Light and Coke Co.

Hicks, Richard S. October 17, 1894.
73 Warren street, New York, N. Y.

Higby, William R. October 18, 1888.
380 Main street, Bridgeport, Conn., President of Bridgeport Gas Light Co.

Hill, William H. October 19, 1892.
40 Water street, Boston, Mass., Lock Box 185, President of Citizens' Gas Light Co., Quincy, Mass.

Hofmann, G. Max. October 19, 1898.
Fort Wayne, Ind., General Superintendent Fort Wayne Gas Co.

Holden, Thos. F. October 20, 1897.
12th and M streets, S. E. Washington, D. C., Superintendent East Station Works, Washington Gas Light Co.

Holzer, Edwin G. October 17, 1894.
204 Terry Building, Roanoke, Va., P. O. Drawer 12, Superintendent of Gas Department, Roanoke Gas and Water Co.

Hookey, George S. May 13, 1874.
303 Centre street, Augusta, Ga.

Hopper, William H. October 18, 1882.
131 West Walnut lane, Germantown, Philadelphia, Pa., Director in Warsaw Gas Light Co., Wis.

Hostetter, D. Herbert. October 16, 1889.
59 Water street, Pittsburg, Pa., P. O. Box 835, President of Pittsburg Gas Co.

Hough, David Leavitt. October 19, 1892.
117 West 58th street, New York, N. Y., Consulting Engineer and Contractor.

Humphreys, Alexander C. October 20, 1875.
31 Nassau street, New York, N. Y., Humphreys & Glasgow, Gas Engineers, New York and London; President Syracuse Gas Co. and City Gas Co. of Norfolk, Va.

Humphreys, C. J. R. October 19, 1881.
360 Essex street, Lawrence, Mass., P. O. Box K, Agent of Lawrence Gas Co.

Humphreys, James J., Jr. October 19, 1898.
Worcester, Mass., Superintendent Worcester Gas Light Co.

Hyde, Gustavus A. October 18, 1882.
85 Kennard street, Cleveland, Ohio, Engineer of Cleveland Gas Light and Coke Co.

Isbell, Charles W. May 12, 1875.
245 Broadway, New York, N. Y., President of Isbell-Porter Co., Gas Engineers and Contractors.

Jackson, Walter M. October 19, 1887.
(9 Oliver street, Stamford, Conn.) New York, N. Y., P. O. Box 808.

Jenkins, E. H. October 21, 1891.
43 Massachusetts street, Buffalo, N. Y., Engineer with Buffalo City Gas Co., Buffalo Gas Light Co., and Buffalo Mutual Gas Light Co.

Jenks, Zeuner M. October 16, 1895.
169 Main street, Woonsocket, R. I., Superintendent of Woonsocket Gas Co.

Jones, Edward C. October 15, 1879.
415 Post street, San Francisco, Cal., Engineer of San Francisco Gas and Electric Co.

Jones, T. C. October 19, 1898.
Delaware, Ohio, Superintendent and Secretary Delaware Gas Co.

Jourdan, James H. October 21, 1891.
Nevins and Degraw streets, Brooklyn, N. Y., Chief Engineer of Western Division Brooklyn Union Gas Co.

Kellogg, L. L. October 15, 1890.
528 5th street, Sioux City, Iowa, Manager of Sioux City Gas Light Co.

Kelly, H. H. October 19, 1892.
49 Chestnut street, Chelsea, Mass , Superintendent of Chelsea Gas Light Co.

Kempf, John, Jr. October 19, 1898.
Salt Lake City, Utah, General Manager Salt Lake & Ogden Gas and Electric Light Co.

Keppelman, John H. October 21, 1891.
20 North 5th street, Reading, Pa., P. O. Box 384, Superintendent of the Consumers' Gas Co.

Kingsbury, Frank D. May 13, 1874.
8 East Market street, Corning, N. Y., P. O. Box 884, Treasurer and General Manager of Corning Gas Co.

Knapp, Isaac N. October 19, 1898.
20th and Centre streets, Omaha, Neb., Superintendent Omaha Gas Co.

Knight, C. S. October 15, 1890.
Murfreesboro, Tenn., Secretary Murfreesboro Gas and Electric Light Co.

Knight, D. E. October 19, 1898.
Marysville, Cal., President Marysville Gas Co.

Knight, Elmer B. October 21, 1891.
Far Rockaway, Long Island, N. Y., P. O. Box 331, Superintendent of the Town of Hempstead Gas and Electric Light Co.

Knowles, W. P. October 27, 1896.
Richmond, Va., Superintendent of City Gas Works.

Kreischer, George F. October 21, 1885.
119 East 23d street, New York, N.Y., President of B. Kreischer & Sons, Gas Retort Manufacturers.

Krumholz, Joseph. October 19, 1887.
186-188 Main street, Buffalo, N. Y., Secretary of Buffalo Gas Light Co., Buffalo City Gas Co., and The Buffalo Mutual Gas Light Co.

Kuehn, Jacob L. October 19, 1881.
33 East Philadelphia street, York, Pa., P. O. Box 344, Superintendent and Engineer of York Gas Co.

Lamson, Charles D. October 19, 1881.
240 Main street, Worcester, Mass., President and General Manager of Worcester Gas Light Co.

Lane, James W. October 21, 1891.
1046 West 4th street, Williamsport, Pa., Superintendent and Engineer of Williamsport Gas Co.

Langford, John T. October 17, 1883.
70 Kilby street, Boston, Mass., Contracting Engineer.

Lawrence, W. F. October 19, 1898.
Trenton, N. J., Superintendent Trenton Gas Light Co.

Leach, Henry B. October 18, 1882.
68 Washington street, Taunton, Mass., P. O. Box 76, Agent and Treasurer of Taunton Gas Light Co.

Learned, Charles A. October 27, 1896.
47 Washington street, Meriden, Conn., P. O. Box 1375, Superintendent and Manager of Meriden Gas Light Co. and Meriden Electric Light Co.

Learned, Everett C. October 19, 1881.
118 Maple street, New Britain, Conn., P. O. Box 355, Superintendent of New Britain Gas Light Co.

Learned, Waldo A. October 18, 1882.
2 Jewett street, Newton, Mass., P. O. Box 14, General Superintendent of Newton and Watertown Gas Light Co.

Lee, Edward C. October 20, 1886.
813 Drexel Building, Philadelphia, Pa., Secretary and Treasurer of The United Gas Improvement Co. and Welsbach Light Co.

Leetch, John. October 17, 1894.
1409 31st street, Washington, D. C., General Manager of Washington Gas Light Co.

Light, Joseph. October 21, 1885.
203 East First street, Dayton, Ohio, Superintendent of Dayton Gas Light and Coke Co.

Lillie, Lewis. October 21, 1891.
813 Drexel Building, Philadelphia, Pa., Comptroller of the United Gas Improvement Co.

Little, F. W. October 20, 1897.
223 East Market street, Akron, Ohio, Vice-President and General Manager The Akron Gas Company.

Littlehales, Thomas. May 13, 1874.
402 East Genesee street, Syracuse, N. Y.

Littlehales, Thomas G. October 19, 1898.
Hopkinsville, Ky., Lessee and Manager Hopkinsville Gas and Lighting Co.

Littleton, Augustus W. October 16, 1889.
111 South 5th street, Quincy, Ill., Secretary and Superintendent of Quincy Gas Light and Coke Co.

Lloyd, John. October 27, 1896.
First National Bank, Altoona, Pa., President of Altoona Gas Co.

Logan, John D. October 18, 1893.
Brooklyn, E. D., N. Y., P. O. Box 6, Station G, Vice-President of Greenpoint Gas Light Co.

Logan, William J. October 19, 1892.
Brooklyn, E. D., N. Y., P. O. Box 6, Station G, Proprietor of Logan Iron Works.

Loomis, Burdett. October 15, 1884.
Hartford, Conn., Builder of Water Gas Works.

Lowe, Thaddeus S. C. October 20, 1886.
Pasadena, Cal., President of Pasadena Gas and Electric Light Co.

Ludlam, Edwin. October 15, 1873.
180 Remsen street, Brooklyn, N. Y., P. O. Box 76, Secretary of Brooklyn Union Gas Co.

Lynch, Eugene T. October 16, 1895.
Detroit, Mich., President of Detroit Gas Co.

Lynn, James T. October 17, 1883.
717 Trumbull avenue, Detroit, Mich., President of Port Huron Gas Co., Port Huron, Mich.

Macdonald, Benjamin J. October 15, 1890.
70 Water street, Newburg, N. Y., P. O. Box 94, Secretary and Treasurer of Consumers' Gas Co.

MacDonald, William. October 16, 1889.
Point Breeze, Philadelphia, Pa., Superintendent Station G, U. G. I. Co.

MacMillan, George. October 21, 1891.
565 Oneida street, Appleton, Wis., P. O. Box 28, President, Manager and Treasurer of Appleton Gas, Light and Fuel Co., of Appleton, Wis.

Marani, Virgil G. October 20, 1897.
356 Superior street, Cleveland, Ohio, Assistant Engineer Cleveland Gas Light and Coke Company.

Max, William J. October 20, 1897.
13 William street, Middletown, N. Y., Superintendent Middletown Gas and Electric Light Company.

Mayer, Frederick T. October 15, 1884.
McHenry and Scott streets, Baltimore, Md., Engineer with Bartlett, Hayward & Co.

Mayers, J. A. October 19, 1898.
131 Lafayette avenue, Detroit, Mich., Superintendent of Streets, Detroit City Gas Company.

McCleary, Alexander J. October 17, 1888.
22d and Filbert streets, Philadelphia, Pa., Sup't Street Lighting Dep't of The Equitable Illuminating Gas Light Co.

McCullough, Edmund H. October 18, 1882.
224 South 3d street, Philadelphia, Pa., President of Westmoreland Coal Co.

McDonald, William. October 15, 1879.
51 Lancaster street, Albany, N. Y., Secretary and Treasurer of Bath Gas Co., Bath, N. Y.

McElroy, John H. May 13, 1874.
435 Sixth avenue, Pittsburg, Pa., P. O. Box 835, Engineer of Pittsburg Gas Co.

McIlhenny, James S. October 15, 1890.
26th and G streets, N. W., Washington, D. C., Superintendent of Washington Gas Light Co.

McIlhenny, John. May 12, 1875.
1339 Cherry street, Philadelphia, Pa., Helme & McIlhenny, Meter Manufacturers.

McIlhenny, John D. October 16, 1895.
1339 Cherry street, Philadelphia, Pa., President of Citizens' Gas and Fuel Co., Terre Haute, Ind.

McKay, William E. October 19, 1892.
10 Pearl street, Dorchester, Mass., Engineer in charge of Calf Pasture Station of Bay State Gas Co.

McKeige, Ferdinand. October 15, 1890.
31 Nassau street, New York, N. Y., Secretary and Treasurer of Standard Gas Light Co.

McLean, George. October 19, 1898.
Dubuque, Iowa, Secretary and Manager Key City Gas Co.

McLean, John R. October 17, 1894.
413 10th street, N. W., Washington, D. C., President of Washington Gas Light Co.

McMillin, Emerson. May 13, 1874.
40 Wall street, New York. N. Y., President of Columbus Gas Light and Coke Co., Laclede Gas Co., Milwaukee Gas Co., Grand Rapids Gas Co., Madison, Wis. Gas & Electric Co., and Consolidated Gas Co. of New Jersey, etc.

Merrifield, L. L. October 19, 1898.
157 Dowling avenue, Toronto, Canada, Gas Engineer Canadian Gas Association.

Merritt, Charles H. October 15, 1879.
350 Main street, Danbury, Conn., P. O. Box B, President of Danbury and Bethel Gas and Electric Light Co.

Middleton, Robert L. October 17, 1894.
1333 30th street, N. W., Washington, D. C., Superintendent of Georgetown Gas Light Co.

Miller, Alten S. October 16, 1889.
340 Third avenue, New York, N. Y., Chief Engineer of New Amsterdam Gas Co.

Miller, C. O. G. October 21, 1891.
Cor. Annie and Stevenson streets, San Francisco, Cal., Treasurer of Pacific Gas Improvement Co., also Secretary and Treasurer of Pacific Lighting Co.

Miller, William A. October 27, 1896.
2817 Eastern avenue, Cincinnati, Ohio, Superintendent of Manufacture, Cincinnati Gas Light Co.

Milsted, William N. October 19, 1887.
512 West 22d street, New York, N. Y., Secretary of American Meter Co.

Mitchell, Kerr M. October 16, 1889.
516 Francis street, St. Joseph, Mo., General Manager of St. Joseph Gas Co.

Moore, Northrop. October 19, 1898.
Kansas City, Kansas, Superintendent Wyandotte Gas Co.

Morgans, William H. October 19, 1887.
36 Wessen street, Pontiac, Mich., Superintendent of L. R. Medbury Gas Works.

Morrell, Edward E. October 20, 1897.
Oak Park, Ill., Vice-President and Engineer Cicero Gas Co.

Morris, Henry G. October 15, 1879.
926 Drexel Building, Philadelphia, Pa., Engineer and Machinist.

Morrison, H. K. October 19, 1898.
Concord, N. H., Superintendent Concord Light and Power Co.

Morton, Fred N. October 16, 1895.
Clinton avenue and 13th street, Hoboken, N. J., Superintendent of Hudson County Gas Light Co.

Moses, Frank D. October 17, 1894.
111 Lake street, Chicago, Ill., Engineer and Contractor.

Moses, George W. October 13, 1880.
187 Winnisimmet street, Chelsea, Mass., Treasurer of Chelsea Gas Light Co.

Nash, Abner F. October 21, 1891.
6357 Ingleside avenue, Chicago, Ill.

Neal, George B. May 13, 1874.
Thompson square, Charlestown, Mass., Treasurer and General Manager of Charlestown Gas and Electric Co.

Nettleton, Charles H. October 20, 1875.
22 Elizabeth street, Derby, Conn., P. O. Drawer L, Treasurer and Agent of Derby Gas Co.

Nix, Joshua J. October 16, 1895.
353 Church street, Royersford, Pa., P. O. Box 158, Lessee of Spring City and Royersford Gas Light Co.

Norcross, J. A. October 27, 1896.
9 Victoria street, London, S. W., England, Manufacturing Expert, Humphreys and Glasgow.

Norris, Rollin. October 16, 1889.
813 Drexel Building, Philadelphia, Pa., Superintendent of Works of The United Gas Improvement Co.

Norton, Walter F. October 19, 1898.
55 Concord street, Nashua, N. H., Superintendent Nashua Light, Heat and Power Co.

Nute, Joseph E. October 17, 1888.
14 Bedford street, Fall River, Mass., P. O. Box 66, Superintendent of Fall River Gas Works Co.

Page, Carter H., Jr. October 18, 1893.
813 Drexel Building, Philadelphia, Pa., Gas Engineer with the United Gas Improvement Co.

Page, F. D. October 27, 1896.
316 Main street, Fitchburg, Mass., P. O. Box 575, Asst. Superintendent of Fitchburg Gas and Electric Light Co.

Park, William K. October 21, 1885.
22d and Filbert streets, Philadelphia, Pa., Consulting Engineer Philadelphia Gas Works, United Gas Improvement Co.

Parker, Richard Marsh. October 19, 1898.
420 Market street, McKeesport, Pa., Treasurer McKeesport Gas and Improvement Co.

Parker, T. R. October 19, 1898.
Napa, Cal., General Manager Napa City Gas Light and Heating Co.

Payne, Milton J. October 21, 1885.
10th and Walnut streets, Kansas City, Mo., President of Kansas City, Missouri, Gas Co.

Pearson, William H. October 20, 1875.
19 Toronto street, Toronto, Ont., General Manager and Secretary of Consumers' Gas Co.

Pearson, William H., Jr. October 17, 1888.
95 Isabella street, Toronto, Ont., Engineer and Superintendent of Consumers' Gas Co.

Perkins, James D. October 18, 1882.
228 Produce Exchange, New York, N. Y., Perkins & Co., Gas Coal Dealers.

Pierson, Henry M. October 19, 1892.
25 Whitehall street, New York, N. Y., Consulting Engineer of Plattsburg Light, Heat and Power Co.

Pinkney, Edward A. October 21, 1891.
29 Whitesboro street, Utica, N. Y., General Manager and Engineer of Equitable Gas and Electric Co.

Poor, Frank B. October 27, 1896.
Hackensack, N. J., President of Hackensack Gas and Electric Light Co.

Porter, J. F. October 27, 1896.
205 Market street, Alton, Ill., President and Treasurer of Alton Railway and Illuminating Co.

Pratt, Edward G. October 20, 1886.
413 Locust street, Des Moines, Iowa, Manager of Capitol City Gas Light Co.

Prichard, Charles F. October 17, 1883.
90 Exchange street, Lynn, Mass., General Superintendent of Lynn Gas and Electric Co.

Printz, Eugene. May 13, 1874.
188 North 5th street, Zanesville, Ohio, Superintendent of Zanesville Gas Light Co.

Quilty, C. W. October 19, 1898.
San José, Cal., President San José Light and Power Co.

Quinn, Andrew K. October 19, 1887.
181 Thames street, Newport, R. I., P. O. Box 305, Treasurer of Newport Gas Light Co.

Ramsdell, George G. October 15, 1879.
222 South 3d street, Philadelphia, Pa., General Manager of American Gas Co.

Randolph, William W. October 17, 1894.
31 Nassau street, New York, N. Y., Assistant to the President Syracuse Gas Co., N. Y. and City Gas Co. of Norfolk, Va.

Rathell, Walter S. October 18, 1893.
4th and Washington streets, Waco, Texas, P. O. Drawer 68, Local Manager Waco Gas Co. and Citizens' Railway Co.

Rawn, John C. October 21, 1891.
Roanoke, Va., P. O. Drawer 749, Manager and Engineer of Roanoke Gas and Water Co.

Raynor, Charles H. October 15, 1873.
11 North Winter street, Adrian, Mich., Secretary of Adrian Gas Co.

Reichelt, A. F. October 20, 1897.
350 Alexander avenue, New York City, Secretary and Treasurer Central Union Gas Co.

Reilly, John W. October 21, 1891.
116 South 6th street, Wilmington, N. C., Superintendent of Wilmington Gas Light Co.

Rice, Harry L. October 17, 1894.
Norfolk, Va., P. O. Box 305, Superintendent City Gas Co. of Norfolk.

Richardson, Frank S. October 19, 1881.
71 Main street, North Adams, Mass., P. O. Box 853, Vice-President, Treasurer and Manager of North Adams Gas Light Co.

Ridgely, William. October 21, 1885.
Springfield, Ill., President of Springfield Gas Light Co.

Ringwood, Thomas. October 15, 1890.
4 Armory street, Ilion, Herkimer County, N. Y., P. O. Box 1023, President of Ilion and Mohawk Gas Light Co.

Roberts, George J. October 17, 1894.
813 Drexel Building, Philadelphia, Pa., Gas Engineer with the United Gas Improvement Co.

Rogers, W. H. October 17, 1894.
146 Ellison street, Paterson, N. J., P. O. Box 408, Agent of the United Gas Improvement Co.

Roots, D. T. October 17, 1883.
Connersville, Ind., President of P. H. & F. M. Roots Co., Exhauster Manufacturers.

Rosenthal, Albert. October 19, 1898.
1315 Filbert street, Philadelphia, Pa., Superintendent of Special Mains, Philadelphia Gas Works, United Gas Improvement Co.

Ross, Alexander. October 27, 1896.
411 North 11th street, St. Louis, Mo., Secretary and General Manager of Laclede Gas Light Co.

Ross, J. Charles. October 19, 1898.
Port Chester, N. Y., Superintendent Westchester Gas and Electric Co.

Rossman, G. M. October 19, 1898.
Keene, N. H., Treasurer Keene Gas Light Co.

Rowland, Charles L. October 17, 1888.
61 Morton street, Brooklyn, N. Y., Consulting Engineer of Williamsburgh Gas Light Co.

Rowland, Thomas F. May 13, 1874.
329 Madison avenue, New York, N.Y., President of the Continental Iron Works, Brooklyn, N. Y.

Rowland, Thomas F. Jr. October 19, 1881.
170 Keep street, Brooklyn, N. Y., P. O. Station G, Secretary and Treasurer of Continental Iron Works.

Rowland, William L. October 20, 1886.
4800 Chester avenue, Philadelphia, Pa., Superintendent of Ammonia Co. of Philadelphia.

Rusby, John M. October 17, 1888.
6th and Provost streets, Jersey City, N. J., P. O. Drawer R, Superintendent of the United Gas Improvement Co., Jersey City Works.

Russell, Daniel R. October 19, 1887.
417 Pine street, St. Louis, Mo., Vice-President of Parker-Russell Mining and Manufacturing Co.

Russell, Henry Z. October 17, 1894.
Honesdale, Pa., Secretary and Treasurer of Honesdale Gas Co.

Scott, William M. October 19, 1898.
Lewiston, Me., Superintendent Lewiston Gas Light Co.

Schniewind, F. October 27, 1896.
Care of New England Gas & Coke Co., Everett, Mass.

Scrafford, William H. October 19, 1887.
Bath, N. Y., P. O. Box 93, Superintendent of Bath Gas Co.

Searle, Robert M. October 15, 1890.
Broad and Alabama streets, Atlanta, Ga., P. O. Box 311, Superintendent of Atlanta Gas Light Co.

Seaverns, F. October 17, 1883.
228 Produce Exchange, New York, N. Y., Treasurer of Perkins & Co., Coal Dealers.

Serrill, William J. October 21, 1891.
813 Drexel Building, Philadelphia, Pa., Engineer of Allentown Gas Co., Allentown, Pa.

Shattuck, John D. October 19, 1898.
720 Ellincott Square, Buffalo, N. Y., Engineer of Distribution People's Gas Light and Coke Co.

Shelton, Frederick H. October 17, 1888.
525 Drexel Building, Philadelphia Pa.; Welsbach Commercial Co.

Sherman, F. C. October 20, 1875.
80 Crown street, New Haven, Conn., P. O. Drawer 3, Superintendent of New Haven Gas Light Co.

Sisson, Frank N. October 20, 1886.
139 Lancaster street, Albany, N. Y., Superintendent at Albany of Welsbach Commercial Co.

Slade, James. October 17, 1883.
95 Woodworth avenue, Yonkers, N. Y., Superintendent of Yonkers Gas Light Co.

Slade, Richmond E. October 19, 1892.
White Plains, N. Y., P. O. Box 393, Superintendent and Secretary of Citizens' Gas and Electric Co.

Slaney, Henry C. October 16, 1889.
466 6th street, Brooklyn, N. Y., Gas Engineer.

Slater, A. B. October 15, 1873.
Rear 20 Market square, Providence, R. I., P. O. Drawer 1422, Treasurer, Secretary and General Manager of Providence Gas Co.

Slater, A. B., Jr. October 18, 1888.
101 Public street, Providence, R. I., P. O. Box 1160, Superintendent and Engineer of Providence Gas Co.

Slater, Howard C. October 27, 1896.
245 Oneida street, Milwaukee, Wis., P. O. Box 423, Superintendent of Milwaukee Gas Light Co.

Smith, John W. October 20, 1886.
60 Laurel street, Philadelphia, Pa., Superintendent of Northern Liberties Gas Co.

Smith, Marcus. May 13, 1874.
Welles Building, Public square, Wilkesbarre, Pa., Secretary and Superintendent of Wilkesbarre Gas Co.

Smith, Robert A. C. October 17, 1883.
100 Broadway, American Surety Building, New York, N. Y.

Smith, William H. October 21, 1891.
1319 Filbert street, Philadelphia, Pa., Superintendent of Distribution City District of United Gas Improvement Co.

Snow, William H. October 19, 1887.
338 Maple street, Holyoke, Mass., P. O. Box 552, Superintendent of Holyoke Gas Works.

Somerville, James. October 20, 1875.
Cor. Penn and Louisiana streets, Indianapolis, Ind., Engineer and Superintendent of Indianapolis Gas Co.

Spangenberg, B. H. October 20, 1897.
St. Augustine, Fla., Superintendent St. Augustine Gas and Electric Light Co.

Spaulding, Charles F. October 16, 1878.
Warren avenue, Waltham, Mass., Superintendent of Waltham Gas Light Co.

Spaulding, William H. October 16, 1889.
98 Walnut street, Clinton, Mass., P. O. Box 1094, Superintendent of Clinton Gas Light Co.

Spragle, L. D. October 19, 1898.
Johnstown, N. Y., Superintendent Johnstown and Gloversville Gas Co.

Sprague, Charles H. October 18, 1882.
70 Kilby street, Boston, Mass., P. O. Box 3105.

Stacey, James E. October 27, 1896.
39 Mill street, Cincinnati, Ohio, General Manager of Florence (Ala.) Gas Co.

Stacey, William. October 19, 1887.
39 Mill street, Cincinnati, Ohio, Vice-President of the Stacey Manufacturing Co.

Stanley, Ira N. May 12, 1875.
310 Washington avenue, Brooklyn, N. Y., Gas Engineer.

Starr, James M. October 20, 1875.
10th and North D streets, Richmond, Ind., Vice-President Light, Heat and Power Co.

Steck, Henry. October 21, 1891.
631 Chestnut street, room 12, Philadelphia, Pa., President of Hagerstown (Md.) Light and Heat Co.

Stedman, William A. October 17, 1877.
785 Flatbush avenue, Brooklyn, N. Y., General Manager of Flatbush Gas Co.

Stirzel, J. W. October 16, 1895.
Richmond and Tioga streets, Philadelphia, Pa., Superintendent of Station B, United Gas Improvement Co. and Equitable Illuminating Gas Light Co.

Strecker, Alexander H. October 20, 1897.
Newark, N. J , Engineer and Superintendent of The Newark Gas Co.

Stroud, Morris W. October 16, 1895.
222 South Third street, Philadelphia, Pa., Secretary and Treasurer of the American Gas Co.

Summers, George F. October 20, 1897.
109 E. 24th street, New York, N. Y.

Summers, Thomas W. October 19, 1892.
Hornellsville, N. Y., P. O. Box 326, Secretary and Superintendent of the Hornell Gas Light Co.

Taber, Robert B. October 19, 1881.
Boston, Mass., P. O. Box 3462, Gas and Electric Engineer.

Tayler, George H. October 18, 1882.
209 Main street, Warren, Ohio, Secretary, Treasurer and Superintendent of Warren Gas Light Co.

Thomas, John W. October 19, 1898.
Vallejo, Cal., Superintendent Vallejo Gas Light Company.

Thompson, G. Treadway. October 21, 1891.
40 Wall street, New York, N. Y., Assistant to E. McMillin, President Laclede Gas Light Co., etc.

Thwing, Orrell O. October 16, 1895.
Main and Howard streets, St. Louis, Mo., Superintendent of Station B, Laclede Gas Light Co.

Tobey, Franklin, Jr. October 19, 1892.
112 Jansen avenue, Kingston, N. Y., General Manager Kingston Electric Co.

Turner, Thomas. May 13, 1874.
224 Calhoun street, Charleston, S. C., P. O. Box 6, President and Superintendent of Charleston Gas Light Co.

Tuthill, J. B. T. October 19, 1898.
Salem, Oregon, General Manager Salem Gas Co.

Vanderpool, Eugene. October 16, 1873.
757 Broad street, Newark, N. J., Civil and Consulting Engineer.

Voorhis, A. M. October 17, 1894.
Broadway, Nyack, N. Y., P. O. Box 114, President, Treasurer and Manager of Nyack Gas Light and Fuel Co.

Wakeman, E. A. October 19, 1898.
Batavia, N. Y., Superintendent Consolidated Gas and Electric Co.

Walbridge, H. D. October 17, 1894.
42 Congress street West, Detroit, Mich, Detroit City Gas Co.

Waldo, Charles S. October 20, 1886.
102 Milk street, Boston, Mass., P. O. Box 3436, Waldo Bros., Gas Retorts and General Supplies.

Waldo, John A. October 19, 1887.
102 Milk street, Boston, Mass., P. O. Box 3436, Waldo Bros., Gas Retorts and General Supplies.

Wales, Harry B. October 19, 1898.
Grand Rapids, Mich., Chief Clerk Grand Rapids Gas Light Co.

Walker, James H. October 18, 1882.
249 27th street, Milwaukee, Wis., Gas Engineer, The Milwaukee Gas Stove Co.

Walters, Anderson H. October 21, 1891.
405 Main street, Johnstown, Pa., Secretary and Superintendent of Consumers' Gas Co.

Ward, William H. October 19, 1892.
228 Front street, Easton, Pa., Superintendent of Easton Gas Co.

Warmington, Daniel R. October 21, 1891.
412 Pearl street, Cleveland, Ohio, Superintendent and Engineer of the Peoples Gas Light Co.

Warmington, George H. May 13, 1874.
412 Pearl street, Cleveland, Ohio, President of the Peoples Gas Light Co.

Watson, Charles. October 19, 1881.
432 Federal street, Camden, N. J., Secretary and Treasurer of Camden Gas Light Co.

Watt, Anthony. October 21, 1891.
10th street and Central avenue, Connersville, Ind., P. O. Box 27, Superintendent of Connersville Gas and Electric Co.

Weber, Adam. October 13, 1880.
633 East 15th street, New York, N.Y., Proprietor of Manhattan Fire Brick and Enameled Clay Retort Works.

Weber, Oscar B. October 17, 1883.
633 East 15th street, New York, N. Y., Manager of Manhattan Fire Brick and Enameled Clay Retort Works.

Wehner, Adolph F. October 17, 1894.
245 Broadway, New York, N. Y., Secretary Isbell-Porter Co.

Wells, L. W. October 19, 1898.
Canton, Ohio, Superintendent Canton Gas Light and Coke Co.

Westcott, John T. October 18, 1893.
19 Abingdon street, Westminster, London, S. W. Eng., Manager of the Economical Gas Apparatus Construction Co.

Wheeler, Fred B. October 18, 1893.
30 Chenango street, Binghamton, N. Y., P. O. Box 653, General Manager Binghamton Gas Works.

Whipple, Henry S. October 19, 1898.
Rockford, Ill., Superintendent Rockford Gas Light and Coke Co.

White, Clement A. May 13, 1874.
16 St. James Court, Louisville, Ky.

White, Edward D. October 17, 1883.
265 Stuyvesant avenue, Brooklyn, N. Y., President of Brooklyn Fire Brick Works.

White, Henry H. October 21, 1891.
Portsmouth, Va., P. O. Box 39, Superintendent of Portsmouth Gas Co.

White, Wm. Henry. April 16, 1873.
32 Pine street, New York, N. Y., Engineer and Contractor.

Whitney, Henry C. October 21, 1891.
19 Anthony street, Watertown, N.Y., Secretary and Superintendent of Watertown Gas Light Co.

Whittaker, Alan Dean. October 19, 1898.
Paterson, N. J., Assistant Superintendent The United Gas Improvement Co.

Whittier, Charles R. October 19, 1887.
45 Broadway, New York, N. Y., care of C. W. Hunt Co.

Wilcox, John F. October 27, 1896.
311 Lewis Block, Pittsburg, Pa., Manager of United Coke and Gas Co.

Williams, E. H. October 17, 1888.
150 Grand street, Waterbury, Conn., P. O. Box 223, Agent and Superintendent of the United Gas Improvement Co.

Williams, L. S. October 19, 1898.
706 North 8th street, Sheboygan, Wis., Superintendent Sheboygan National Gas Co.

Williams, W. L. October 15, 1890.
183 Tyler street, Paterson, N. J., Superintendent of the United Gas Improvement Co., for Paterson and People's Gas Light Co.

Williamson, John. October 18, 1893.
2 East Madison street, Chicago, Ill., Assistant Engineer of Chicago Gas Light and Coke Co.

Witherby, Edwin E. October 19, 1898.
Lockport, N. Y., Superintendent and Secretary Lockport Gas and Electric Light Co.

Wood, Austin C. April 16, 1873.
216 North West street, Syracuse N. Y., President of Homer and Cortland Gas Light Co.

Wood, Walter. October 19, 1881.
400 Chestnut street, Philadelphia, Pa., P. O. Box 1935, of R. D. Wood & Co., also Treasurer of Millville Gas Light Co.

Wood, William A. October 16, 1889.
609 Commercial street, Boston, Mass., Assistant Engineer of Boston Gas Light Co.

Woods, George E. October 20, 1897.
31 Nassau street, New York City, General Superintendent and Chief Engineer Standard Gas Light Co.

Woodward, Ralph. October 19, 1898.
New Rochelle, N. Y., Superintendent New Rochelle Gas and Fuel Co.

Wortendyke, Ira F. October 27, 1896.
5 North Main street, Janesville, Wis., Superintendent of New Gas Light Co.

Yorke, Eugene H. October 19, 1881.
Portland, Me., Engineer of Portland Gas Co.

Young, James M. H. October 20, 1897.
Pittsburg, Pa., Superintendent South Side Gas Co.

Young, John. October 18, 1882.
31 West Diamond street, Allegheny, Pa., Superintendent of the Allegheny Heating Co.

Young, Peter. October 21, 1885.
722 Ellicott Square, Buffalo, N. Y., General Manager Peoples Gas Light & Coke Co.

Young, Robert. October 20, 1875.
Sixth avenue, Pittsburg, Pa., General Manager Consolidated Gas Co. of City of Pittsburg.

Zeek, Charles F. October 15, 1890.
3 South Palafox street, Pensacola, Fla., Superintendent of Pensacola Gas Co.

Zollikofer, Oscar F. October 19, 1892.
65 West 54th street, New York, N. Y., Secretary of Consolidated Gas Co.

ASSOCIATE MEMBERS.

Alcott, Franklyn L. October 19, 1898.
Cleveland, Ohio, General Manager and Secretary The Standard Lighting Co.

Allen, Walter S. October 19, 1892.
New Bedford, Mass.

Althouse, Wilson D. October 20, 1897.
Room 719, Reading Terminal, Philadelphia, Pa., Coal Merchant, Althouse & Kennedy.

Atwater, Christopher G. October 19, 1898.
Syracuse, N. Y., Engineer Semet-Solvay Co.

Backus, Q. S. October 17, 1894.
Williamsport, Pa., President and General Manager of Backus Manufacturing Co.

Barrett, S. E. October 18, 1893.
909 Chicago Stock Exchange, Chicago, Ill., President and Treasurer of S. E. Barrett Manufacturing Co.

Barrows, William E. October 16, 1889.
835 Drexel Building, Philadelphia, Pa., President and General Manager of Welsbach Light Co.

Bartlett, D. Lewis. October 19, 1898.
Care Bartlett, Hayward & Co., Baltimore, Md., Manufacturer Gas Works Apparatus.

Battin, William I. October 19, 1898.
3701 Powelton avenue, Philadelphia, Pa., Foreman of Mains, West Philadelphia District, Philadelphia Gas Works, United Gas Improvement Co.

Bayles, James C. October 19, 1898.
M. E., Ph. D., 14 Cortlandt street, New York, N. Y., Chief Engineer Bayles Engineering Co.

Behrend, Fritz. October 17, 1894.
10 and 12 Old Slip, New York, N. Y., Clay Gas Retort Importer.

Birchmore, W. H. October 20, 1897.
117 Nassau street, New York, N. Y., Gas Chemist.

Brown, Frank H. October 19, 1892.
Waltham, Mass., Treasurer and Superintendent of Davis & Farnham Manufacturing Co.

Buss, Julius. October 19, 1892.
118 Farwell avenue, Milwaukee, Wis., P. O. Box 235, Consulting Engineer with Fred Bredel, Gas Engineer and Contractor.

Carpenter, H. A. October 20, 1897.
Allegheny, Pa., Engineer with Riter-Conley Mfg. Co.

Coburn, Cyrus M. October 19, 1892.
152 Congress avenue, Chelsea, Mass., Manager of Liberty Oil Co.

Coleman, H. W. October 19, 1898..
625 Drexel Building, Philadelphia, Pa., Eastern Agent Kerr-Murray Manufacturing Co.

Collins, David J. October 17, 1894.
813 Drexel Building, Philadelphia, Pa., Sales Agent of the United Gas Improvement Co.

Crane, William M. October 16, 1889.
1133 Broadway, New York, N. Y., President Wm. M. Crane Co., Gas Stoves, etc.

Curley, Edward J. October 18, 1893.
827 Market street, Wilmington, Del., Assistant Superintendent of Wilmington Coal Gas Co.

Dart, Edward M. October 19, 1892.
136 Clifford street, Providence, R. I., Manager of E. M. Dart Manufacturing Co., Manufacturers of Gas Appliances.

DeHart, J. S., Jr. October 19, 1898.
46 Bridge street, Newark, N. J., Engineer with Isbell-Porter Co.

Dougherty, H. N. October 27, 1896.
Brooklyn, E. D., N. Y., Box 6, Station G, General Salesman for Farrell, Logan & Son.

Drummond, M. J. October 20, 1897.
192 Broadway, New York, N. Y., Manufacturer of Cast Iron Pipe.

Duck, George F. October 19, 1898.
1 Broadway, New York, N. Y., Gas Coal Agent Peale, Peacock and Kerr.

Eaton, Alfred B. October 27, 1896.
67 Washington street, Chicago, Ill., Assistant Sales Agent of The United Gas Improvement Co.

Floyd, James R., Jr. October 19, 1898.
539 West 20th street, New York, N. Y., member of the firm of James R. Floyd's Sons.

Graves, George W. October 20, 1897.
36 St. Paul street, Rochester, N. Y., Eastern Manager National Vapor Stove and Manufacturing Co.

Harris, Andrew. October 15, 1890.
1513 Race street, Philadelphia, Pa., care of J. A. Harris.

Hartenfels, P. October 20, 1897.
120 Liberty street, New York, N. Y., Manufacturer of Patent Leak Detector for Street Mains.

Hayward, Sterling F. October 15, 1890.
357 Canal street, New York, N. Y., Treasurer and General Manager of Connelly Iron Sponge and Gov. Co.

Henderson, E. H. October 27, 1896.
335 5th avenue, Pittsburg, Pa., P. O. Box 373, Sales Agent for James Gardner, Jr.

Higgins, C. M. October 21, 1891.
26 Broadway, New York, N. Y., with Standard Oil Co.

Hinman, Charles W. October 27, 1896.
63 Beverly street, Boston, Mass., Manager for Nathaniel Tufts Meter Co.

Jacobs, Charles H. October 20, 1897.
3d and Learned streets, Detroit, Mich., Secretary, Treasurer and General Manager of Detroit Meter Co.

Little, George B. October 19, 1892.
103 State street, Boston, Mass., of Stratton, Little & Co., Coal Dealers.

Manning, James S. October 21, 1891.
18 Vesey street, New York, N. Y., Agent of Otto Gas Engine Co.

Mansur, John H. October 17, 1894.
436 Walnut street, Royersford, Pa., P. O. Box 226, President of Keystone Meter Co.

Mather, Henry A. October 17, 1894.
421 Greenpoint avenue, Brooklyn, N.Y., President and Secretary of Greenpoint Chemical Works.

McDonald, Donald. October 21, 1891.
51 Lancaster street, Albany, N. Y., Superintendent of D. McDonald & Co., Gas Meter Manufacturers.

Meyer, Hermann H. B. October 18, 1893.
Nevins and Degraw streets, Brooklyn, N. Y., Brooklyn Union Gas Co.

Mordue, Thomas N. October 16, 1895.
Old Colony Building, Chicago, Ill., Agent, Castner, Curran & Bullitt.

Nicolls, J. O. October 27, 1896.
1326 Chestnut street, Philadelphia, Pa., Treasurer of Shaner Coal Co.

Norton, Harry A. October 17, 1888.
8 Medford street, Boston, Mass., Manager N. Tufts Meter Co.

Osborne, Williard B. October 19, 1898.
Allegheny, Pa., Constructing Engineer Riter-Conley Co.

Osius, George. October 16, 1889.
Foot of Beaufait avenue, Detroit, Mich., Secretary and Treasurer of Michigan Ammonia Works.

Page, Albion L. October 21, 1891.
69 Wall street, New York, N. Y., of Geo. Shepard Page's Sons.

Pearson, Joshua Ash. October 20, 1897.
833 Drexel Building, Philadelphia, Pa., Assistant Purchasing Agent, The United Gas Improvement Co.

Persons, Fred R. October 17, 1888.
408 Prescott street, Toledo, Ohio, Representative of Maryland Meter and Mfg. Co.

Platt, E. S. October 27, 1896.
Room 218, Commercial Building, St. Louis, Mo., Secretary and Treasurer of George Platt & Co.

Poole, Herman. October 19, 1898.
Care American Gas Light Journal, 32 Pine street, New York, N. Y., Consulting Chemist and Engineer.

Prendergast, Daniel J. October 20, 1897.
33 Nassau street, New York City, General Superintendent Welsbach Street Lighting Company of America.

Roper, George D. October 27, 1896.
Rockford, Ill., President and Manager of Eclipse Gas Stove Co.

Scheel, Henry C. October 18, 1893.
11 Broadway, Room 921, New York, N. Y., P. O. Box 2228, Wholesale Coal Dealer.

Schell, Edward. October 19, 1892.
99th street and 2d avenue, New York, N. Y., Assistant Superintendent of 99th and 111th street Stations, Consolidated Gas Co.

Slocum, Frank L. October 19, 1892.
Conestoga Building, Pittsburg, Pa., President of the Gas Engineering Co.

Starr, George W. October 16, 1895.
New Haven, Conn., P. O. Box 1532.

Stratton, S. S. October 16, 1889.
107 West Monroe street, Chicago, Ill., Salesman Maryland Meter Co.

Summey, D. L. October 19, 1898.
Wyncote, Pa., Engineer The Jenkintown and Cheltenham Gas Co.

Thomas, Frederick W. October 19, 1892.
102 Milk street, Boston, Mass., Salesman, Waldo Bros.

Trenkamp, H. J. October 19, 1898.
Cleveland, Ohio, Secretary The Schneider & Trenkamp Company.

Van Wie, E. G. October 27, 1896.
1320 Jefferson avenue, Detroit, Mich., Manager Gas Appliance Department, Detroit Stove Works.

Van Wie, Peter G. October 18, 1888.
Hamilton, Ohio, Supervisor of Gas Appliances, F. & L. Kahn & Bros.

Wehner, R. K. October 19, 1898.
46 Bridge street, Newark, N. J., Manager Isbell-Porter Co.

Wells, Fred K. October 27, 1896.
72 Lake street, Chicago, Ill., Treasurer, George M. Clarke & Co.

Wharton, Henry. October 16, 1895.
224 South 3d street, Philadelphia, Pa., P. O. Box 1322, Assistant Secretary, Westmoreland Coal Co.

Wilbraham, John S. October 19, 1892.
2518 Frankford avenue, Philadelphia, Pa., Secretary and Treasurer of Wilbraham-Baker Blower Co.

Wilbraham, John W. October 19, 1892.
2518 Frankford avenue, Philadelphia, Pa., President of Wilbraham-Baker Blower Co.

Wilke, Frederick A. October 17, 1894.
1114 North E street, Richmond, Ind., Manufacturer of the Wilke China Kiln.

Wilson, Peter. October 19, 1892.
25 Witherspoon street, Princeton, N. J.

Honorary Members	9
Active Members	416
Associate Members	70
Total	495

MEMBERS OF THE AMERICAN GAS LIGHT ASSOCIATION, ARRANGED GEOGRAPHICALLY.

CALIFORNIA.

Anaheim	William J. Fay.	
Los Angeles	W. B. Cline.	
Marysville	D. E. Knight.	
Napa	T. R. Parker.	
Oakland	John A. Britton	13th and Clay streets
Pasadena	Thaddeus S. C. Lowe.	
Red Bluff	John Clements.	
San Francisco	Joseph B. Crockett	415 Post street
	Frederick H. Eichbaum	2644 Howard street
	Edward C. Jones	415 Post street
	C. O. G Miller	Annie and Stevenson streets
San José	C. W. Quilty	
Vallejo	John W. Thomas	

COLORADO.

Denver	A. H. Branch	405 17th street

CONNECTICUT.

Bridgeport	William R. Higby	380 Main street
Danbury	Charles H. Merritt	350 Main street
Derby	Charles H. Nettleton	22 Elizabeth street
Hartford	John P. Harbison	700 Main street
	John W. Hatstat.	
	Burdett Loomis.	
Meriden	Charles A. Learned	47 Washington street
New Britain	Everett C. Learned	118 Maple street
New Haven	F. C. Sherman	80 Crown street
	George W. Starr.	
Norwalk	L. C. Hanford	1 Belden avenue

Stamford	Walter M. Jackson	9 Oliver street
Waterbury	E. H. Williams	150 Grand street

DELAWARE.

Wilmington	Edward Betts	827 Market street
	George S. Capelle	827 Market street
	Edward J. Curley	827 Market street
	Thomas Curley	827 Market street

DISTRICT OF COLUMBIA.

Washington	Thos. F. Holden	12th and M streets, S.E.
	John Leetch	1409 31st street
	James S. McIlhenny,	26th & G streets, N.W.
	John R. McLean,	413 10th street, N.W.
	Robert L. Middleton	1333 30th street, N.W.
Tacoma Park	Allen R. Foote.	

FLORIDA.

Jacksonville	Clarence S. Hammatt	26 Main street
Pensacola	Charles F. Zeek	3 South Palafox street
St. Augustine	B. H. Spangenberg.	
Tampa	A. J. Boardman	Roberts Building

GEORGIA.

Athens	J. T. Bowdoin Cocke.	
Atlanta	W. G. Abel	42 West Baker street
	W. L. Cosgrove	Alabama and Broad streets
	R. M. Searle	Broad and Alabama streets
Augusta	George S. Hookey	303 Centre street
Columbus	James Ferrier	315 12th street
Savannah	James A. P. Crisfield,	7 Congress street, West

ILLINOIS.

Alton	J. F. Porter	205 Market street
Cairo	John W. Eakin	709 Levee street

Chicago	S. E. Barrett	909 Chicago Stock Exchange
	Walter S. Dole	Cologne & Deering avenue
	A. B. Eaton	67 Washington street
	Chas. H. Evans,	4133 Cottage Grove avenue
	F. D. Moses	111 Lake street
	Thomas N. Mordue	Old Colony Building
	Abner F. Nash	6357 Ingleside avenue
	S. S. Stratton	107 West Monroe street
	Fred K. Wells	72 Lake street
	John Williamson	2 East Madison street
Elgin	Carl H. Dunbar.	
	Robert F. Fitz.	
Oak Park	Edward E. Morrell.	
Quincy	Augustus W. Littleton	111 South 5th street
Rockford	George D. Roper.	
	Henry S. Whipple.	
Springfield	William Ridgely.	

INDIANA.

Connersville	D. T. Roots.	
	Anthony Watt,	10th street and Central avenue
Fort Wayne	Alfred D. Cressler	Calhone & Murray streets
	Olaf N. Guldlin	11 Webster street
	G. Max Hofmann.	
Indianapolis	James Somerville,	cor. Penn & Louisiana sts.
New Albany	James W. Dunbar	Sycamore and 7th streets
Peru	H. M. Buck.	
Richmond	James M. Starr	10th and North D streets
	Frederick A. Wilke	1114 North E street
Terre Haute	M. N. Diall	507 Ohio street

IOWA.

Burlington	Edward D. Clary	911 North 6th street
Des Moines	Edward G. Pratt	413 Locust street
Dubuque	George McLean.	
Oskaloosa	William Bailey.	
Sioux City	L. L. Kellogg	528 5th street

KANSAS.

Fort Scott .....William H. Frost.....11 East Wall street
Kansas City .....Northrop Moore.

KENTUCKY.

Hopkinsville .....Thomas G. Littlehales.
Louisville.....Clement A. White .....16 St. James Court
A. H. Barret.

LOUISIANA.

New Orleans .....Francis Carroll..... 1643 Perdido street

MAINE.

Lewiston .....William M. Scott.
Portland.....Eugene H. Yorke.

MARYLAND.

Baltimore.....Edward L. Bartlett, McHenry & Scott streets
Lewis D. Bartlett.
George Beadenkopf.....19 South street
Charles H. Dickey..North and Saratoga sts.
Francis H. Hambleton .....19 South street
Thomas J. Hayward, McHenry and Scott sts.
Frederick T. Mayer, McHenry and Scott sts.

MASSACHUSETTS.

Boston .....Frederick P. Addicks .....24 West street
Walter R. Addicks .....24 West street
Forrest E. Barker.....State House, Room 145
Albert C. Burrage .....24 West street
Fred J. Davis.....74 Montgomery street
W. W. Greenough ...299 Marlborough street
William H. Hill .....40 Water street
Charles W. Hinman.....63 Beverly street
John T. Langford.....70 Kilby street
George B. Little .....103 State street

Boston	Harry A. Norton	8 Medford street
	Charles H. Sprague	70 Kilby street
	Robert B. Taber	8 Oliver street
	Frederick W. Thomas	102 Milk street
	Charles S. Waldo	102 Milk street
	John A. Waldo	102 Milk street
	William A. Wood	609 Commercial street
Charlestown	Patrick Coyle	27 Arlington avenue
	George B. Neal	Thompson square
Chelsea	Cyrus M. Coburn	152 Congress avenue
	Henry H. Kelly	49 Chestnut street
	George W. Moses	187 Winisimmet street
Chicopee	Walter P. Elliott.	
Clinton	William H. Spaulding	98 Walnut street
Dorchester	William E. McKay	10 Pearl street
Everett	F. Schniewind.	
Fall River	Joseph E. Nute	14 Bedford street
Fitchburg	H. F. Coggeshall	316 Main street
	F. D. Page	316 Main street
Gloucester	John A. Coffin	Duncan street
Holyoke	William H. Snow	338 Maple street
Jamaica Plain	Eugene N. Foss	8 Everett street
Lawrence	C. J. R. Humphreys	360 Essex street
Lynn	Charles C. Fry	90 Exchange street
	Charles F. Prichard	8 Central square
New Bedford	Walter S. Allen.	
	Nathaniel W. Gifford.	
Newton	Waldo A. Learned	2 Jewett street
North Adams	Frank S. Richardson	71 Main atreet
Northampton	David W. Crafts	116 Main street
Springfield	Samuel J. Fowler.	
Taunton	Henry B. Leach	68 Washington street
Waltham	Frank H. Brown.	
	Charles F. Spaulding	Warren avenue
Worcester	Charles D. Lamson	240 Main street
	James J. Humphreys, Jr.	

MICHIGAN.

Adrian	Charles H. Raynor	11 North Winter street
Ann Arbor	Henry Douglas	107 South 5th avenue

Detroit	Isaac C. Baxter	636 Trumbull street
	Jerome Croul	Lewis block, room 4
	Charles H. Jacobs.	
	Eugene T. Lynch.	
	James T. Lynn	Russell House
	J. A. Mayers	131 Lafayette avenue
	George Osius	Beaufait avenue
	E. G. Van Wie	1320 Jefferson avenue
	H. D. Walbridge	42 Congress street, west
Grand Rapids	Paul Doty	107 Ottawa street
	Harry B. Wales.	
Pontiac	William H. Morgans	36 Wessen street

MISSOURI.

Kansas City	George S. Clarke	10th and Walnut streets
	Milton J. Payne	10th and Walnut streets
St. Joseph	Kerr M. Mitchell	516 Francis street
St. Louis	Byron E. Chollar	411 North 11th street
	John Dell	916 Wainwright Building
	James Green	915 Wainwright Building
	E. S. Platt	218 Commercial Building
	Alexander Ross	411 North 11th street
	Daniel R. Russell	417 Pine street
	Orrell O. Thwing	Main and Howard streets

NEBRASKA.

Omaha	Isaac Battin	1224 Farnam street
	Isaac N. Knapp	20th and Centre streets

NEW HAMPSHIRE.

Concord	H. K. Morrison.	
Keene	G. M. Rossman.	
Manchester	Walter G. Africa	46 Hanover street
Nashua	Walter F. Norton	55 Concord street

NEW JERSEY.

Camden	Benjamin F. Archer	319 Cooper street
	Charles Watson	432 Federal street
	Carl H. Graf.	
Hackensack	Frank B. Poor.	

Hoboken ..... Henry Morton ..... Stevens Institute
F. N. Morton, Willow avenue and 13th street
Montclair ..... A. E. Forstall.
Jersey City ..... West Bissell.
David R. Daly ..... Green and Essex streets
Dudley D. Flemming .. 249 Washington street
John M. Rusby ..... 6th and Provost streets
Lambertville ..... A. C. Gandy ..... 31 Bridge street
Newark ..... Samuel Philip Curtis ..... Market street
J. S. DeHart, Jr. ..... 46 Bridge street
Thomas B. Fogarty .... 300 South 11th street
Alexander H. Strecker.
Eugene Vanderpool ..... 757 Broad street
R. K. Wehner ..... 46 Bridge street
Paterson ..... W. H. Rogers ..... 146 Elison street
W. L. Williams ..... 183 Tyler street
Alan Dean Whittaker.
Princeton ..... James E. Burke.
Peter Wilson ..... 25 Witherspoon street
Trenton ..... W. F. Lawrence.

NEW YORK.

Albany ..... Donald McDonald ..... 51 Lancaster street
William McDonald ..... 51 Lancaster street
Frank N. Sission ..... 139 Lancaster street
Batavia ..... E. A. Wakeman.
Bath ..... William H. Scrafford.
Binghamton ..... Fred B. Wheeler ..... 30 Chenango street
Brooklyn ..... Fred S. Benson, Kent avenue and Cross street
Charles W. Blodget ..... 324 Bedford avenue
Robert W. Bush, 12th st. and Gowanus Canal
Thomas E. Byrne ..... 5th and Hoyt streets
Charles H. Corbett .... 428 Lafayette avenue
H. N. Dougherty.
James H. Jourdan, Nevins & Degraw streets
John D. Logan
William J. Logan.
Edwin Ludlam ..... 180 Remsen street
Henry A. Mather.

Brooklyn	Herman H. B. Meyer,	Nevins & Degraw sts.
	Charles L. Rowland	61 Morton street
	T. F. Rowland, Jr.	170 Keap street
	Henry C. Slaney	466 6th street
	Ira N. Stanley	310 Washington avenue
	William A. Stedman	785 Flatbush avenue
	Edward D. White	265 Stuyvesant avenue
Buffalo	John J. Clahan	133 Whitney place
	John H. Cowing	186 Main street
	J. T. Herron	249 W. Genesee street
	E. H. Jenkins	43 Massachusetts street
	Joseph Krumholz	186 Main street
	John D. Shattuck	720 Ellicott square
	Peter Young	722 Ellicott square
Corning	Frank D. Kingsbury	8 East Market street
Far Rockaway, L.I.,	Elmer B. Knight.	
Hornellsville	T. W. Summers.	
Ilion, Herkimer Co.	John A. Giblin	8 East Main street
	Thomas Ringwood	4 Armory street
Johnstown	L. D. Spragle.	
Kingston	Franklin Tobey, Jr.	112 Jansen avenue
Lockport	Edwin E. Witherby.	
Middletown	William J. Max	13 William street
Mt. Vernon	Charles L. Gerould,	N. Third & Prospect aves.
Newburg	Benjamin J. McDonald	70 Water street
New Rochelle	Ralph Woodward.	
New York	William A. Armington	256 W. 23d street
	J. C. Bayles, M. E., Ph. D.,	14 Cortlandt st.
	Thaddeus R. Beal	138th st. and East River
	William R. Beal	350 Alexander avenue
	Fritz Behrend	10 and 12 Old Slip
	W. H. Birchmore	117 Nassau street
	Fred L. Bradley	99th st. and 2nd avenue
	William H. Bradley	4 Irving place
	Ernest C. Brown	280 Broadway
	John S. Bush	1845 Vanderbilt avenue
	John Cabot	553 West 33d street
	E. P. Callender	32 Pine street
	William Carpender	32 Pine street
	C. F. Chandler	41 East 49th street

New York	William M. Crane	1133 Broadway
	J. Alfred Dixon	160 Broadway
	Robert M. Dixon	160 Broadway
	W. F. Douthirt	40 Wall street
	George F. Duck	1 Broadway
	M. J. Drummond	192 Broadway
	George B. Edwards	113 Chambers street
	Frederick W. Floyd	539 West 20th street
	Henry E. Floyd	539 West 20th street
	James R. Floyd	539 West 20th street
	James R. Floyd, Jr	539 West 20th street
	Arthur H. Hall	350 Alexander avenue
	P. Hartenfels	120 Liberty street
	Sterling F. Hayward	357 Canal street
	Richard S. Hicks	73 Warren street
	C. M. Higgins	26 Broadway
	David L. Hough	117 West 58th street
	Alexander C. Humphreys	31 Nassau street
	Charles W. Isbell	245 Broadway
	George F. Kreischer	119 East 23d street
	E. G. Love	122 Bowery
	Ferdinand McKeige	31 Broadway
	J. S. Manning	18 Vesey street
	Emerson McMillin	40 Wall street
	William N. Milsted	512 West 22d street
	Alten S. Miller	340 Third avenue
	Albion L. Page	69 Wall street
	James D. Perkins	228 Produce Exchange
	Henry M. Pierson	25 Whitehall street
	Herman Poole	32 Pine street
	Daniel J. Prendergast	33 Nassau street
	William W. Randolph	31 Nassau street
	A. F. Reichelt	350 Alexander avenue
	Thomas F. Rowland	329 Madison avenue
	Henry C. Scheel	11 Broadway, room 921
	Edward Schell	99th street and 2d avenue
	F. Seaverns	228 Produce Exchange
	Robert A. C. Smith	100 Broadway
	George F. Summers	109 E. 24th street
	G. Treadway Thompson	40 Wall street

New York	Adam Weber	633 East 15th street
	Oscar B. Weber	633 East 15th street
	A. F. Wehner	245 Broadway
	William Henry White	32 Pine street
	Charles R. Whittier	45 Broadway
	George E. Woods	31 Nassau street
	Oscar F. Zollikoffer	65 West 54th street
Niagara Falls	Louis A. Boore.	
Nyack	A. M. Voorhis	Broadway
Ogdensburg	J. H. Findlay	17 Franklin street
Port Chester	Charles J. Ross.	
Port Jervis	John Collins	1 Mt. William
Poughkeepsie	James M. Hadden.	
Rochester	G. W. Graves	36 St. Paul street
Syracuse	Christopher G. Atwater.	
	Philip Cross	
	T. Littlehales	
	Austin C. Wood	216 North West street
Utica	Edward A. Pinkney	29 Whitesboro street
Watertown	Henry C. Whitney	19 Anthony street
White Plains	Richmond E. Slade.	
Yonkers	James Slade	95 Woodworth avenue

NORTH CAROLINA.

Brevard	Arthur E. Boardman.	
Raleigh	M. Bowes.	
Wilmington	John W. Reilly	116 South 6th street

OHIO.

Akron	F. W. Little	223 East Market street
Bucyrus	J. W. Gwynn.	
Canton	L. W. Wells.	
Cincinnati	Andrew Hickenlooper	838 Dayton street
	William A. Miller	2817 Eastern avenue
	William Stacey	39 Mill street
	James E. Stacey	39 Mill street
Cleveland	Franklyn L. Alcott.	
	Malcolm S. Greenough	356 Superior street

Cleveland	Gustavus A. Hyde	85 Kennard street
	Virgil G. Marani	356 Superior street
	Daniel R. Warmington	412 Pearl street
	H. J. Trenkamp.	
	George H. Warmington	412 Pearl street
Columbus	Irvin Butterworth	135 North Front street
Dayton	W. P. Callahan	901 East Third street
	Robert R. Dickey	Main and 2d streets
	Henry C. Graves	Main and 2d streets
	Joseph Light	203 East First street
Delaware	T. C. Jones.	
Hamilton	Peter G. Van Wie.	
Newark	Beman G. Dawes.	
Toledo	C. A. Byers.	
	Charles R. Faben, Jr.	327 South Erie street
	Fred R. Persons	408 Prescott street
Warren	George H. Tayler	209 Main street
Zanesville	Eugene Printz	188 North 5th street

OREGON.

Portland	Charles F. Adams	5th and Yawhill streets
Salem	J. B. T. Tuthill.	

PENNSYLVANIA.

Allegheny	H. A. Carpenter.	
	Willard B. Osborne.	
	John Young	31 West Diamond street
Allentown	Arthur F. Bigelow	540 Hamilton street
Altoona	George H. Harper	2526 Broad avenue
	John Lloyd	First National Bank
Ardmore	W. E. Barrett	Linwood avenue
Coatesville	P. H. Gibbons	407 Chestnut street
Easton	William H. Ward	228 Front street
Harrisburg	W. G. Chandler	30 North Third street
Honesdale	Henry Z. Russell	Main and 8th streets
Johnstown	Anderson H. Walters	405 Main street
Lancaster	J. H. Baumgardner	129 North Queen street
McKeesport	Richard Marsh Parker	420 Market street

Philadelphia ..... Harry C. Adams.....224 South Third street
J. Edward Addicks.....1500 Market street
W. D. Althouse, Room 719, Reading Terminal
J. C. Andrews.....19th and Allegheny aves.
William E. Barrows ....835 Drexel building
H. S. Battin .....4257 Frankford avenue
William I. Battin ....3701 Powelton avenue
A. B. Beadle .....813 Drexel building
Samuel T. Bodine.....813 Drexel building
Cyrus Borgner .....23d street, above Race
R. B. Brown .....222 South Third street
James Buckman .....8th and Green streets
William Cartwright .....3413 Baring street
Walton Clark .....813 Drexel building
D. J. Collins .....813 Drexel building
H. W. Coleman.....625 Drexel building
F. A. Dingee..... ..720 Reading Terminal
E. J. Donahue.....813 Drexel building
Arthur B. Eilbeck.....Drexel building
George W. Elkins.....423 Walnut street
William L. Elkins, Jr....Land Title building
William P. Fodell.....50 Laurel street
Walton Forstall .....Broad and Arch streets
John Fowler .....39 Laurel street
Alonzo Gartley.....813 Drexel building
William H. Gartley...3044 Richmond street
W. W. Gibbs .....813 Drexel building
W. W. Goodwin .....655 Bourse building
John Gribbel.....1513 Race street
Andrew Harris .....1513 Race street
J. A. Harris.....1513 Race street
Charles D. Hauk.....138 South 6th street
William E. Helme.....1339 Cherry street
William H. Hopper,
131 West Walnut lane, Germantown
Edward C. Lee.....813 Drexel building
Lewis Lillie .....813 Drexel building
William MacDonald..... .Point Breeze
Alex. J. McCleary ...22d and Filbert streets
Edmund H. McCullough..224 South 3d street

Philadelphia	John McIlhenny	1339 Cherry street
	John D. McIlhenny	1339 Cherry street
	Henry G. Morris	926 Drexel building
	J. O. Nicolls	1326 Chestnut street
	Rollin Norris	813 Drexel building
	Carter H. Page, Jr.	813 Drexel building
	William K. Park	22d and Filbert streets
	Joshua Ash Pearson	833 Drexel building
	George G. Ramsdell	222 South 3d street
	George J. Roberts	813 Drexel building
	Albert Rosenthal	1315 Filbert street
	William L. Rowland	4800 Chester avenue
	William J. Serrill	813 Drexel building
	F. H. Shelton	524 Drexel building
	John W. Smith	60 Laurel street
	William H. Smith	1219 Filbert street
	Henry Steck	631 Chestnut street, room 12
	J. W. Stirzel	Richmond and Tioga streets
	Morris W. Stroud	222 South Third street
	Henry Wharton	224 South Third street
	John S. Wilbraham	2518 Frankford avenue
	John W. Wilbraham	2518 Frankford avenue
	Walter Wood	400 Chestnut street
Pittsburg	J. A. Faux	62 Conestoga building
	James Gardner, Jr	335 Fifth avenue
	E. H. Henderson	335 Fifth avenue
	D. Herbert Hostetter	59 Water street
	John L. McElroy	435 Sixth avenue
	Frank L. Slocum	Conestoga building
	John F. Wilcox	311 Lewis block
	J. M. H. Young.	
	Robert Young	Sixth avenue
Reading	John H. Keppelman	20 North 5th street
Royersford	John H. Mansur	436 Walnut street
	Joshua J. Nix	353 Church street
Wilkesbarre	Marcus Smith	Welles bldg., Public square
Williamsport	Q. S. Backus.	
	James W. Lane	1046 West Fourth street
Wyncote	Lewis R. Dutton.	
	D. L. Summey.	

York .....Jacob L. Kuehn..33 East Philadelphia street

RHODE ISLAND.

Bristol .....W. Russell Bogert.
Newport .....A. K. Quinn.....181 Thames street
Providence .....Edward M. Dart.....136 Clifford street
A. B. Slater.....Rear 20 Market square
A. B. Slater, Jr.....101 Public street
Riverside.....James H. Armington.
Woonsocket .....Zeuner M. Jenks.

SOUTH CAROLINA.

Charleston .....Thomas Turner.....224 Calhoun street
Columbia .....John M. Daniels.....1344 Main street

TENNESSEE.

Chattanooga.....James Forbes .....619 Cherry street
Memphis .....J. H. Cardall.....Main and Mill streets
Murfreesboro .....C. S. Knight.

TEXAS.

Galveston .....John Gimper ..... 32d and Market streets
Waco.....Walter S. Rathell..4th and Washington streets

UTAH.

Salt Lake City .....John Kempf, Jr.

VIRGINIA.

Norfolk .....Frederick Egner.....26 Hamilton avenue
Harry L. Rice.
Newport News.....William S. Bowen.
Petersburg .....William H. Baxter .....201 Sycamore street
Portsmouth.....Henry H. White.
Richmond.....W. P. Knowles.
Roanoke .....Edwin G. Holzer.....204 Terry building
John C. Rawn,
Terry building, Jefferson & Campbell sts.

WASHINGTON.

Seattle .....C. Russell Collins.
Spokane Falls.....W. A. Aldrich.

WISCONSIN.

Appleton.....George McMillan .....565 Oneida street
Eau Claire .....David Douglas.

Janesville	Ira F. Wortendyke	5 North Main street
Madison	Henry Doherty.	
Milwaukee	Frederick Bredel	118 Farwell avenue
	Julius Buss.	
	Edward G. Cowdery,	Milwaukee and Michigan streets
	Sheldon J. Glass	Montgomery building
	Howard C. Slater	245 Oneida street
	James H. Walker	249 27th street
Sheboygan	L. S. Williams	706 North Eighth street

ENGLAND.

Liverpool	William King	Duke street
London	Arthur G. Glasgow	S. W., 9 Victoria street
	George T. Livesey	Old Kent Road
	J. A. Norcross	9 Victoria street
	John T. Westcott,	19 Abingdon street, Westminster, S. W.
	Corbet Woodall,	Palace Chamber, Westminster

NOVA SCOTIA.

Halifax	Robert Baxter.	

ONTARIO, CANADA.

Brantford	Wm. M. Cathels.	
Hamilton	Fred W. Gates	17 Herkimer street
	Edmund Cathels.	
Ottawa	John R. Coates	23 Spark street
	Thos. Dunderdale	23 Spark street
Toronto	L. L. Merrifield	157 Dowling avenue
	William H. Pearson	19 Toronto street
	William H. Pearson, Jr.	95 Isabella street

QUEBEC, CANADA.

Quebec	David H. Geggie	2 Place d'Orleans

New England	72
Middle States	248
District of Columbia and South, east of the Mississippi River	36
North of Ohio River, and east of the Mississippi River	82
West of Mississippi River	41
Canada and Nova Scotia	10
England	6
Total	495

MEMBERS DECEASED.

George W. Parsons	Rochester, N. Y	——	—, 1875
Cornelius L. Everett	New York, N. Y	Oct.	—, 1875
G. T. Sutton	Peekskill, N. Y	Apr.	—, 1876
Charles Collier	Selma, Ala	May	—, 1876
W. H. Perry	Bangor, Me	May	—, 1877
William B. Clelland	Vicksburg, Miss	Oct.	15, 1878
Gen. Laz Noble	Vincennes, Ind	Oct.	18, 1879
George Buist	Halifax, N. S	Nov.	2, 1879
Oliver G. Steele	Buffalo, N. Y	Dec.	10, 1879
George W. Edge	Jersey City, N. J	Jan.	1, 1880
Kerr Murray	Ft. Wayne, Ind	May	6, 1880
John C. Buxton	Springfield, O	July	20, 1880
George Dwight	Springfield, Mass	Feb.	1, 1881
Elmer W. Clark, Jr	Philadelphia, Pa	Mar.	5, 1881
Eli Butler	Meriden, Conn	May	24, 1881
Henry Budd	Philadelphia, Pa	May	28, 1881
Henry Cartwright	Philadelphia, Pa	June	30, 1881
Edwin Keith	Taunton, Mass	Apr.	30, 1882
G. Warren Dresser (Honorary)	New York, N. Y	May	27, 1883
M. H. Jones	Easton, Pa	June	1, 1883
W. H. Price	Cleveland, O	June	8, 1883
James D. Merriman	Vera Cruz, Mexico	June	10, 1883
A. W. Richardson	North Adams, Mass	Sept.	4, 1883
Miles W. Caughey	Erie, Pa	Sept.	20, 1883
Wilmer G. Cartwright	Hoboken, N. J	Feb.	23, 1884
Philips Peebles	Quebec, Can	May	15, 1884
Ignaz Herzog	New York, N. Y	Oct.	23, 1884
Thomas Butterworth	Rockford, Ill	Apr.	5, 1885
George Cornell	Youngstown, O	Apr.	22, 1885
Francis Thompson	Charlestown, Mass	Aug.	30, 1885
James D. Brewer	Springfield, Mass	Feb.	7, 1886
Emile J. Durand (Honorary)	Paris, France	Feb.	—, 1886
John Anderson	Ironton, O	June	25, 1886
James H. Walker, Sr	Tonawanda, N. Y	Mar.	1, 1887
T. F. White	Houston, Texas	Feb.	28, 1888
John C. Pratt	Jamaica Plain, Mass	June	7, 1888
William Helme	Atlanta, Ga	June	12, 1888
Joseph H. Collins	Philadelphia, Pa	June	26, 1888
John M. Murphy	Baltimore, Md	Aug.	25, 1888
John McDougall	Hornellsville, N. Y	Nov.	2, 1888
C. H. Nash	St. Louis, Mo	Nov.	9, 1888
John Cartwright	Poughkeepsie, N. Y	Dec.	19, 1888
C. F. Maurice	Sing Sing, N.Y	Dec.	24, 1888
Robert B. Spice (Honorary)	London, England	May	11, 1889
Edward J. King	Jacksonville, Ill	Oct.	28, 1889
Oliver E. Cushing	Lowell, Mass	Jan.	17, 1890

Theobald Forstall	Chicago, Ill	Jan.	19,	1890
William Parrish	Seneca Falls, N. Y	Jan.	19,	1890
Walter B. Houston	Rahway, N. J	Apr.	3,	1890
James Henri Rollins	Worcester, Mass	June	19,	1890
Gen. Chas. Roome (Honorary)	New York, N. Y	June	28,	1890
B. F. Sherman	New York, N. Y	Oct.	31,	1890
Nathaniel Tufts	Boston, Mass	Nov.	9,	1890
Geo. W. Kraft	Philadelphia, Pa	Dec.	22,	1890
William Mooney	New York, N. Y	Jan.	21,	1891
William H. Down	New York, N. Y	Feb.	15,	1891
I. Linton	Ravenna, O	Mar.	—,	1891
J. M. Sterling	Monroe, Mich	May	18,	1891
E. M. Russell	St. Louis, Mo	May	28,	1891
Samuel Prichitt	Nashville, Tenn	Sept.	21,	1891
John Andrew	Chelsea, Mass	Feb.	10,	1892
Geo. Shepard Page	New York, N. Y	Mar.	26,	1892
Charles Nettleton	New York, N. Y	May	5,	1892
Alfred M. Norton	Nashua, N. H	July	13,	1892
George A. McIlhenny	Washington, D. C	Oct.	16,	1892
John J. Griffin	Philadelphia, Pa	Oct.	22,	1892
Austin M. Copp	Boston, Mass	Nov.	1,	1892
Fred H. Odiorne	Boston, Mass	Jan.	3,	1893
Frank H. Dyer	Salt Lake City, Utah	Mar.	—,	1893
Matthew Cartwright	Rochester, N. Y	Apr.	25,	1893
Henry C. Hordley	Cumberland, Md	May	5,	1893
Edward Jones	South Boston, Mass	Aug.	1,	1893
Thomas C. Hopper	Philadelphia, Pa	Feb.	23,	1894
Frederick A. Sabbaton	Troy, N. Y	Apr.	14,	1894
John H. Knowles	Richmond, Va	May	5,	1894
Paul S. Merrifield	New York, N. Y	May	12,	1894
Samuel G. Stiness	Pawtucket, R. I	Nov.	5,	1894
Thomas D. Gilbert	Grand Rapids, Mich	Nov.	18,	1894
Geo. Henry Wells	Nashville, Tenn	Nov.	22,	1894
Thomas C. Cornell	Yonkers, N. Y	Dec.	29,	1894
Sylvester S. Townsend	New York, N. Y	Jan.	14,	1895
Jas. McCutcheon	Pittsburg, Pa	Mar.	4,	1895
Oscar Zollikoffer	New York, N.Y	Apr.	7,	1895
A. P. Collins	New Britain, Conn	Apr.	21,	1895
Wm. C. Adams	Richmond, Va	May	19,	1895
C. A. Bennett, Jr	Freehold, N. J	July	24,	1895
Wilbur H. Townsend	New York, N. Y	Feb.	26,	1896
Jos. R. Thomas	New York, N. Y	Nov.	28,	1896
Jos. D. Weeks	Pittsburg, Pa	Dec.	26,	1896
John W. Newell	New Brunswick, N. J	Jan.	5,	1897
Fred W. Norton	Nashua, N. H	Oct.	2,	1897
W. L. Proctor,	Ogdensburg, N.Y	Nov.	17,	1897
James F. Rogers	Jamaica Plains, Mass	Dec.	18,	1897
Geo. D. Cabot	Lawrence, Mass	Jan.	18,	1898
John Tracey	Poughkeepsie, N. Y	Mar.	19,	1898
Clefford L. Slade	Portchester, N. Y	May	18,	1898
Wm. Gardner	Pittsburg, Pa	Aug.	5,	1898

Number deceased while on Roll.....97

UNIVERSITY OF ILLINOIS-URBANA
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